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Instructions to Contributors

Submission of papers

Papers relevant to the natural history and archaeology of the London Area should be submitted to the editor, Mr K. H. Hyatt, Department of Zoology, British Museum (Natural History), Cromwell Road, London SW7 5BD, before the end of January if they are to be considered for publication in the same year. They should be typed, with double spacing and wide (three cm) margins, on one side of the paper. Authors must retain a duplicate copy. Papers should include at the beginning an abstract, summary or synopsis.

Text

Locality spellings should follow the latest editions of the maps published by the Ordnance Survey. Capitalization should be kept to a minimum. Common names of animals and plants must begin with lower-case initials, and scientific names must be underlined. When both common and Latin names are given there should be no brackets or commas separating them. Genus names should appear in full where first used within each paragraph. When scientific names are taken from a standard work, which must be cited, authorities should be omitted. In descriptive matter numbers under 10 should be in words, except in a strictly numerical context. Dates should follow the logical sequence of day, month, year (i.e. 25 December 1971). Measurements should be in metric and follow the SI system (Système International d'Unités), with imperial equivalents in parentheses where appropriate. There should be no full point following Dr, Mr, Mrs or St. Lists should be in natural, alphabetical or numerical order.

References

Reference citation should be based on the Madison rules (in *Bull. Torrey bot. Club* **22** : 130–132 (1895)) except that a colon should always precede a page number. Capitalization in titles of papers in journals should be kept to a minimum. Journal titles should follow the abbreviations in the *World List of Scientific Periodicals* and be underlined. Examples are as follows:

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Meadows (1970 : 80) or (Meadows 1970).

In references:

MEADOWS, B. S. 1970. Observations on the return of fishes to a polluted tributary of the River Thames 1964–9. *Lond. Nat.* **49** : 76–81.

MELLANBY, K. 1970. *Pesticides and Pollution*. Ed. 2. Collins, London.

WHITE, K. G. 1959. Dimsdale Hall moat, part II. *Trans. a. Rep. N. Staffs. Fld Club* **92** : 39–45.

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E. R. (John) Parrinder, Spurn Bird Observatory, 1952. Photo: Eric Hosking.

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Contents

Report of the Society for 1980*

This has been a relatively quiet year with no dramatic changes, although rising prices and an increase in subscription have meant some inevitable losses.

The programme is still very full with all sections contributing their share. There have been the usual eminent speakers at our monthly general meetings plus the many talks, both formal and informal. Almost every weekend has seen at least one field visit to many localities for the practical pursuit of the various disciplines. We thank all those who have been involved — especially Mr Richard Butler who has again stood in the breach. Attendance at meetings seems to be picking up, and the Bookham Common group has increased the numbers taking part in their monthly surveys after an organised recruiting day. This demonstrates the need for more publicity of the Society both within and outside the membership. It is hoped a series of brief descriptions in the *Newsletter* of the various meetings will encourage members to partake more fully. The annual Symposium still attracts a large turnout. This year the topic is "The History of Natural History", successfully organised by Mr Colin Plant.

The journals continue to be produced, which although taking a large share of our income, are felt to be of prime importance to the status of the Society. We thank all those who edit and despatch the various publications. Mr K. C. Osborne has relinquished the editorship of the *London Bird Report*. We thank him for all the work he has put into its publication during the past few years. Mr Ray Softly and his team do sterling work duplicating and despatching throughout the year. Work has continued on the final stages of the publication for the plant mapping scheme, but it now seems unlikely that the text will be completed by the end of the year.

Various members of the Society have been involved in larger schemes designed to improve communications between workers concerned with biological recording and conservation in the London area.

A tombstone has been erected by the Society at Wimbledon Cemetery in memory of Cyril Castell, one of our benefactors.

With the increase in subscription, we have lost nearly a fifth of our membership, although the numbers of new members are encouraging.

	1980	*1979*
Ordinary	938	*1,017*
Affiliated	20	*20*
Family	99	*101*
Junior	34	*59*
Senior	48	*48*
Honorary	14	*14*
Life	11	*11*
Total	1,164	*1,270*

The deaths have been notified of the following members: Mrs V. Heath, F. J. Holroyde, K. A. Landon, W. Langham, Miss B. M. Morgan, E. R. Parrinder and S. Reading.

We thank, as always, Imperial College for allowing us to use their rooms for meetings, and Mr Whitworth and his staff for the custody of our Library.

* Presented at the Annual General Meeting, 6 December 1980.

The Flora of Southern Epping Forest Part 2: Wanstead Flats and Bush Wood†

by P. R. FERRIS*

Summary

A survey of the flora of Bush Wood and Wanstead Flats, the southern-most extent of Epping Forest, was carried out during the years 1975 to 1979. A total of 250 species of vascular plants was found to occur in these intensively used areas. Although no plants of notable scarcity were recorded, except perhaps unusual garden outcasts and escapes, a notion of how uncommon or scarce many plants are in this area was gained.

Introduction

This second part of a survey of the flora of southern Epping Forest covers Wanstead Flats and Bush Wood, lying within the London Boroughs of Redbridge, Newham and Waltham Forest. This part of the survey was started by the Wren Conservation Group later than that of Wanstead Park (Ferris 1980), though independent records were available from 1975. Because of the different characters of Wanstead Flats and Bush Wood, the main text has been divided into two sections and the systematic list of species indicates whether a plant occurs on Wanstead Flats, in Bush Wood, or both. A comparison may be made with the species occurring in Wanstead Park by referring to Table 1 in Part 1.

A map of Wanstead Flats and Bush Wood (Fig. 1) is included. The names of some of the woods, copses and other areas shown on the maps may not be in general use, but appear here in order to add to their usefulness as illustrations of the text.

Wanstead Flats

The area known locally as 'The Flats' is the southern-most portion of Epping Forest and a welcome intrusion into the suburbs of east London. Heavily built-up areas, primarily of housing, lie immediately to the south and west, though to the north-west it is connected by way of Bush Wood to Leyton Flats and so to more northerly reaches of the Forest.

For the purposes of this survey the borders of Wanstead Flats can be taken as the roads and houses that almost completely surround it. To the east a low wall and high railings separate it from the City of London Cemetery, and in the north-west it adjoins Bush Wood (Fig. 1). Three roads actually cross the Flats, effectively dividing it into four sections.

The greater part of the whole area of some 135 hectares is flat, open grassland on the river gravel of the Taplow Terrace, which overlies the London Clay. Though historically part of a royal forest, the nature of the area encouraged people to turn out cattle and other animals to graze upon this unenclosed land. This practice was eventually recognized and granted as the 'right of common pasture'. Certain landowners and occupiers still have this right, granted them as part of The Epping Forest Act of 1878, and cattle still graze freely. It is probable that continued grazing on this and similar areas of the Forest has helped to maintain the open aspect which they have today. Further details of the history of Epping Forest including Wanstead Flats are given by Qvist (1971).

†Part 1 appeared in *Lond. Nat.* No. 59, 1980.

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Much of the land is liable to a degree of flooding after heavy rain, but also to considerable and quite rapid drying-out in periods of low rainfall. Drainage from the grassland helps to maintain usually three permanent open waters. The largest of these, with two islands to its credit, is Alexandra Lake. Its local name the Sandhills Pond may be attributed to the sandy nature of the low gravel mounds by its banks. The next in size is Dames Road Pond, otherwise known as the Model Yacht Pond. This has stone banks and, as its name implies, is often used for model boating. The smallest is the Round Pond by Capel Road, a circular muddy hollow which can dry out completely in hot weather. The only other semi-permanent pond is that by Lake House Road known as the Cat and Dog Pond, presumably because it only exists when it has been raining 'cats and dogs'. There are some drainage ditches, but few hold water for much time. The only running water is a year-round spring that is the source of one of the 'marshy' areas dominated by rushes that exist in some of the more poorly drained parts of the Flats.

Scattered over the area are some thickets of gorse and broom, as well as a number of small woods and copses. These were planted towards the end of the last century and, together with the many trees lining the roadsides and some avenues, add greatly to the diversity of tree species to be found.

Nearly all the perimeter of Wanstead Flats has a ditch, often with a bank, to prohibit vehicular access. The only vehicles normally allowed are service vehicles and bicycles. Horses may be taken onto the Flats and are supposed to keep to bridle paths marked by posts. There is considerable pedestrian traffic because of the large number of people living nearby and the availability of the area for activities such as fishing in Alexandra Lake, model boating in Dames Road Pond, the flying of model aircraft and kites, birdwatching, botanizing and the exercising of people and dogs; this must have some effect on the ecology of the area.

The playing fields

Large areas of Wanstead Flats are maintained as playing fields, mostly for football and comprising about 66 pitches. Because of the particularly unnatural constitution of this grassland, no account has been taken of the grasses used by the Corporation of London in seeding and reseeding the worn patches. However, some of the seeds used may find their way into adjacent rough grassland and so increase the number of species found there. Plants that occur spontaneously on the playing fields include an abundance of daisy *Bellis perennis* and dandelion *Taraxacum officinale,* both of which can make a beautiful show if not mown too soon. Other plants here include birdsfoot trefoil *Lotus corniculatus,* white clover *Trifolium repens,* black medic *Medicago lupulina* and where the soil has become bare knotgrass *Polygonum aviculare.* On a football pitch to the west of the '1953' plantation sand spurrey *Spergularia rubra* is plentiful.

The rough grassland

Much of Wanstead Flats that is not used for football pitches is rough grassland. Though basically untended, it is grazed by cattle and is somewhat prone to fires, either accidental or maliciously deliberate, during dry weather. Some of the most abundant grasses appear to be common bent *Agrostis tenuis* and red fescue *Festuca rubra rubra,* with much meadow foxtail *Alopecurus pratensis.* Wavy hair-grass *Deschampsia flexuosa* may be found mixed with these and is also in some areas the dominant grass, forming extensive patches. Yorkshire fog *Holcus lanatus* is locally common across the whole area, as is cocksfoot *Dactylis glomerata.* Timothy *Phleum pratense* and smaller catstail *P. bertolonii* are widely spread and common, but crested dogstail *Cynosurus cristatus* is much less so. Another grass which is widespread but not abundant is mat grass *Nardus stricta.*

Tufted hair-grass *Deschampsia caespitosa* is perhaps most common to the south of the '1953' plantation; this small area on the central Flats was planted with trees in 1953 to commemorate the Coronation. Many of the trees are oaks which are still very small, so that the area is primarily grass. Until 1979 the plantation had a wire fence surrounding it, which gave some protection from grazing and trampling. One small patch of heath bedstraw *Galium saxatile* occurs here and is not known elsewhere on Wanstead Flats. This and a patch of creeping willow *Salix repens,* which grows just outside the plantation to the south, are typical of many species that may be found on the Flats, in that they occur infrequently or only in very particular environments within the whole. Other plants to be found in the plantation include white campion *Silene alba* and numerous brambles *Rubus fruticosus* agg. As well as bramble, other plants quite common elsewhere in the rough grassland include curled dock *Rumex crispus,* sheep's sorrel *R. acetosella,* patches of stinging nettle *Urtica dioica,* and common vetch *Vicia sativa.* In the 'Garlic Patch' area, so called because of the amount of crow garlic *Allium vineale,* one of the less common species is tansy *Chrysanthemum vulgare.* Just to the south of Alexandra Lake there is a small but well-established patch of heather *Calluna vulgaris.* To the east of the lake are some plants of harebell *Campanula rotundifolia,* otherwise known only from the vicinity of Long Wood. Various shrubs and bushes are distributed about the Flats; bramble has been mentioned, and gorse *Ulex europaeus* is quite common. One of the thickest scrub areas is near the spring, where gorse, hawthorn and bramble grow together, as well as some broom *Sarothamnus scoparius.* Just across Centre Road from this point broom is abundant and covers an extensive area, known as 'The Broom-fields'. Here too are some buddleia *Buddleja davidii* and dog rose *Rosa canina.* A single large blackthorn *Prunus spinosa* can be found near Aldersbrook Road, just north of the spring. Heath rush *Juncus squarrosus* is found in small quantities widely scattered about the grassland and hairy sedge *Carex hirta* has been found in rather dry grassland near Lake House Road.

The ponds and wet areas

The smallest of the permanent open waters on Wanstead Flats, the Round Pond by Capel Road, has been colonized by comparatively few plants. Of these floating sweet-grass *Glyceria fluitans* and soft rush *Juncus effusus* are prominent. Also present on the mainly bare banks is common spike-rush *Eleocharis palustris.* Dames Road Pond is stone edged and steep sided and thus has no shallows, being some feet deep close to the edge. All around the pond the earth is well trodden and compacted and so supports little plant-life. The water, however, contains Canadian pondweed *Elodea canadensis* as well as an abundance of curled pondweed *Potamogeton crispus.*

Alexandra Lake, the largest of the waters, also has few plants around the edge except for numerous clumps of soft rush, a small amount of trifid bur-marigold *Bidens tripartita,* some grasses, and white clover *Trifolium repens.* The protection afforded by the two islands of the lake has enabled a greater variety of plants to exist here. Yellow flag *Iris pseudacorus* and great water-grass *Glyceria maxima* are present by the waterside on the higher of the two islands, and great willow *Salix caprea* on both of them. On the lower island silver birch *Betula pendula* is numerous. In 1977 a white water-lily *Nymphaea alba* was present in the lake, but why it has not been seen before or since is a mystery.

Below the spring in the north-west corner of the central Flats, where the ground level rises slightly, is a small wet area on the edge of playing fields. Because of the continuing outflow from the spring, it is usually the wettest of the 'marshes' to be found on the Flats. Great water-grass and soft rush are the dominant plants, and amongst these jointed rush *Juncus articulatus* and toad rush *J. bufonius* are also

found. Celery-leaved crowfoot *Ranunculus sceleratus* is present and the plants that occur here have a more rounded fruit-head than is usual in this species. Another large area of 'marsh' is to be found across Centre Road on the Western Flats, consisting predominantly of soft rush, but with some hard rush *Juncus inflexus*.

The trees

Including the smaller species such as elder *Sambucus nigra,* holly *Ilex aquifolium* and hawthorn *Crataegus* spp., 34 species of trees have been found on Wanstead Flats. These can be growing singly in copses and woods, in lines along roadsides, or in avenues. The total number of trees is quite large for an area which could so easily be seen as 'just grassland'.

One of the most widespread species is hawthorn *Crataegus monogyna,* which occurs as isolated specimens, with other species in woods or copses, or even forming something of a small wood itself, as in the area to the east of Alexandra Lake. A solitary tree growing near the south-east corner of this lake is a Midland hawthorn *C. oxyacanthoides,* in this case a variety with red flowers. Another of these grows by Capel Road and a few more on Manor Park Flats. Also in this area, near Forest View Road, are a number of specimens of flowering cherry *Prunus serrulata* and apple *Malus* sp. These are perhaps relics of gardens attached to wartime pre-fabricated houses that stood on this part of the Flats until about 1960. Elder and holly may be found growing wild almost anywhere on the Flats, they often appear as seedlings amongst other vegetation. Another small tree is *Laburnum anagyroides;* only one specimen is known, near Lake House Road. There is also just one aspen *Populus tremula,* by the edge of the hawthorn wood near the spring. Two other species of poplar are present. The hybrid black poplar *Populus* × *canadensis* is found spaced along Centre Road, particularly at the northern end, and an impressive grove of these finishes the avenue of trees that crosses from Bush Wood to the western extremity of the Flats. There is a Lombardy poplar *Populus nigra* 'italica' close to a house near here, and another within the circle of railings that enclose the underground toilets near the junction of Dames Road and Lake House Road. Other trees that have been used for lining roadsides are English oak *Quercus robur,* London plane *Platanus* × *hybrida* and horse chestnut *Aesculus hippocastanum.* The chestnuts along the west end of Capel Road can be a source of danger to motorists when children aim missiles into the branches to collect conkers. There is a red-flowered horse chestnut *A.* × *carnea* by Aldersbrook Road.

The groups of trees often contain a variety of species, although in many oak and beech *Fagus sylvatica* may outnumber the rest. The wood by the north side of Alexandra Lake, for example, contains about sixteen species of which beech is the most abundant. There are, however, almost as many English oak *Quercus robur* and just one red oak *Q. borealis.* There is also just one alder *Alnus glutinosa* and the only conifer on the Flats, a Corsican pine *Pinus nigra laricio.* On the western Flats there is a copse that contains about equal numbers of the two species of oak just mentioned, plus a few hornbeam *Carpinus betulus.* In the 'East' copse on the central Flats, beech is the most abundant species, but with almost as many oaks comprising almost equal numbers of red oak and English oak. There are also two whitebeams *Sorbus aria* and a number of silver birch *Betula pendula,* although in 1979 only one of these was still alive. Unfortunately the majority of birches all over the Flats are dead or dying. These trees are probably at the end of their natural life-span here, and the drought of 1976 may have helped to hasten their end. Only on the islands of Alexandra Lake are there many still living. The elms *Ulmus* spp. too, are mostly gone although many persist as suckers from a dead tree or its stump.

The roadside verges and houses

Nearly all of Wanstead Flats is surrounded by either roads or by the back gardens of houses. The roadside verges often consist of a ditch, sometimes with a bank. All too often the ditches need to be cleared of dumped rubbish, creating a disturbed situation in which many plants are to be found. Creeping thistle *Cirsium arvense* and lesser burdock *Arctium minus* are common in this situation. Red dead-nettle *Lamium purpureum* and black horehound *Ballota nigra* are quite common along the banks, the latter particularly in stretches along Capel Road. Some less common plants also manage to survive in the ditches. There has been for some years one tiny patch of ivy-leaved toadflax *Cymbalaria muralis* hanging on to the side of a ditch by Capel Road. Rather more prominent at the end of this road near the Round Pond is some wormwood *Artemisia absinthum*. Mugwort *A. vulgaris* is much commoner by the roadsides.

Man's disturbance of the verges has resulted in more species of plants on Wanstead Flats than would otherwise occur. The rubbish deposited here includes outcast garden plants and seeds. The double-flowered forms of feverfew *Chrysanthemum parthenium* and soapwort *Saponaria officinalis* that are well established may be examples of species introduced in this way. There is a mass of soapwort by Aldersbrook Road at the Manor Park end of the Flats. This roadside bank is especially interesting in that there are no houses nearby and there is no footpath on either side of the road. Cornflower *Centaurea cyanus* has been found there and it is possible that this originated from seeds thrown from a passing car. There is also a garden pansy *Viola* sp. in the ditch nearby, usually nearly covered with leaves.

Almost certainly some deliberate sowing and planting does take place, usually near to houses. The edge of the Flats by the back gardens of the houses in Belgrave Road by the north Flats is particularly rich in unusual plants, including balm *Melissa officinalis,* snowdrop *Galanthus nivalis,* three-cornered leek *Allium triquetrum* and spotted dead-nettle *Lamium maculatum.*

At the edge of Bush Wood by the north end of the track leading to the wood by these houses is a patch of wood sage *Teucrium scorodonia.* This is probably natural and is not known elsewhere on Wanstead Flats.

Bush Wood

Bush Wood is a predominantly wooded area of about 13 hectares. To the south it merges into part of Wanstead Flats, and for the purpose of this survey a purely artificial boundary between the two areas has been taken as the footpath from Belgrave Road to the road called Bushwood (Fig. 1). The rest of the southern boundary consists of the garden fences of the houses in Belgrave Road. The other three sides are the roads Bushwood, Bush Road and Blake Hall Road. There are two buildings that project into the wood. One of these, in the north-east corner, is an Epping Forest Keeper's lodge. The other, by Bush Road, is a Quaker Meeting House with a high brick wall surrounding its large garden.

West of this wall the area being considered is mostly grassland, but with trees along the edge of the wall and along Bushwood. Near the south end of the wall is a clearing which reaches into the centre of the wood, and there is another less-wooded area along the southern boundary running parallel to the tree avenue.

There are two ponds in Bush Wood, both surrounded by trees and somewhat prone to drying out. Indeed, the smaller of the two hardly deserves to be called a pond, being often little more than a muddy rush-filled hollow.

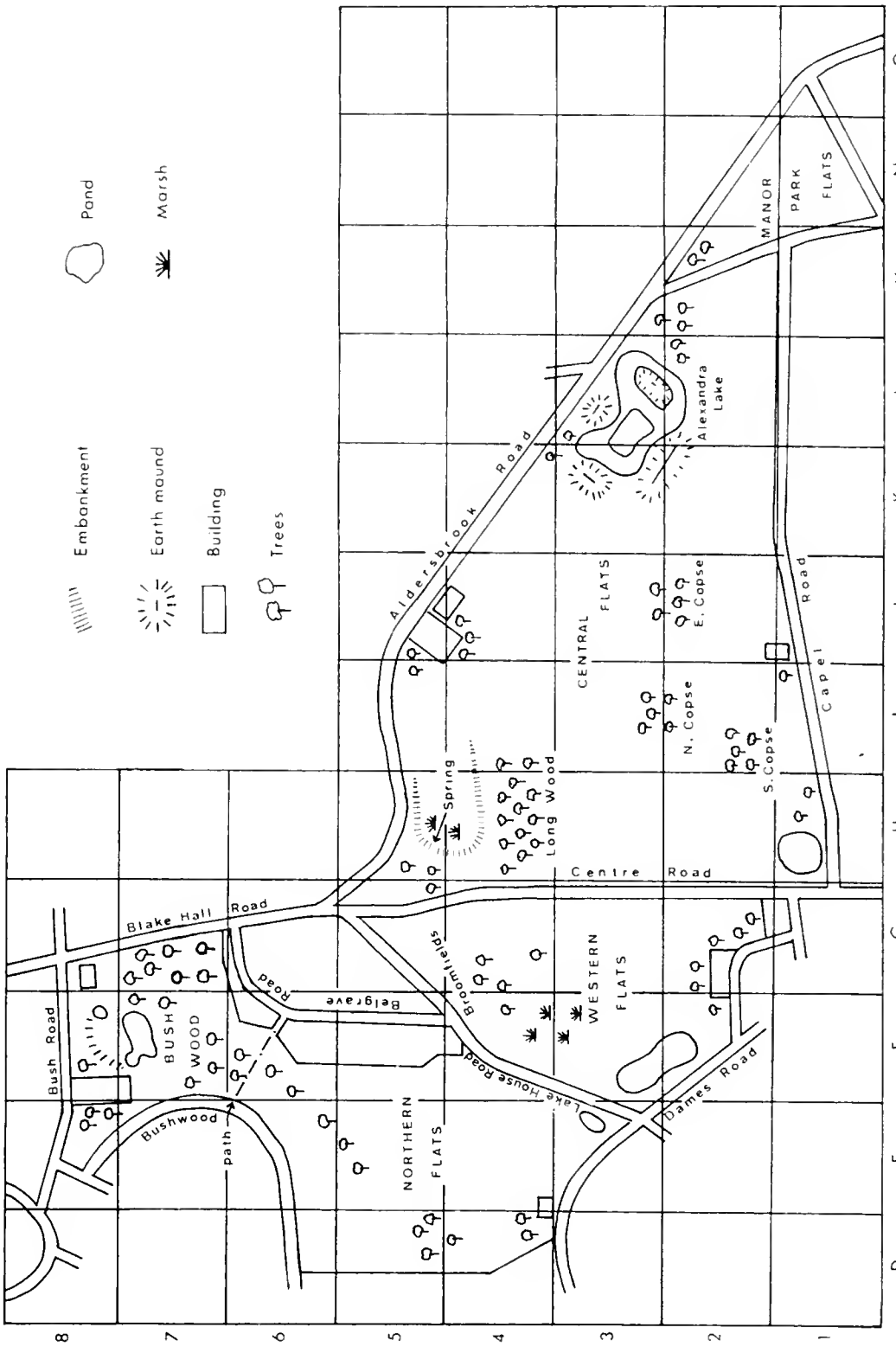

FIG. 1. Wanstead Flats and Bush Wood, 1979.

The close spacing of the trees of Bush Wood give it a very different character to Wanstead Flats, and the fact that these trees are neither pollarded nor coppiced makes it quite unlike much of the rest of Epping Forest.

The woodland

Because Bush Wood is relatively small and lacking in diverse habitats, it has considerably fewer species than either Wanstead Flats or Wanstead Park. The woodland is dominated by English oak *Quercus robur* with thickets of hawthorn *Crataegus monogyna* and holly *Ilex aquifolium.* There is also much hornbeam *Carpinus betulus,* as mature trees and seedlings. These hornbeams, unlike many in other parts of Epping Forest, have not been pollarded and so are of natural shape. One or two of them are aberrant specimens, being tall and narrow instead of having the more usual rounded outline. These four species give Bush Wood its overall character, though in all 22 species of trees have been found.

Some of the largest trees are sweet chestnut *Castanea sativa,* of which there are about eight specimens. Between Bush Road and the larger pond is a particularly impressive tree, even though many of its upper branches are missing; the soil on one side has been eroded, exposing giant roots under which children can sometimes be seen to crawl. Horse chestnut *Aesculus hippocastanum* occurs mainly in the northern part of the wood; for example there are about five specimens near the Keeper's lodge. Sycamore *Acer pseudoplatanus* is common, though more often as a seedling than as a mature tree. Field maple *A. campestre* is less common. Only one specimen of Norway maple *A. platanoides* has been found, near the south boundary fence. Another tree which, like sycamore, regenerates readily in the wood is grey poplar *Populus canescens;* the greatest concentration being on the south edge of the clearing.

Of the less common trees, beech *Fagus sylvatica* is only to be found as a group of four near Bush Road to the west of the wall around the Quaker Meeting House grounds. Also in this vicinity are two locust trees *Robinia pseudoacacia* which may have originated from specimens that grow inside the private grounds of the Meeting House. Further south along the edge of this wall are a whitebeam *Sorbus aria* and some saplings. In a few scattered locations in the wood rowan *S. aucuparia* may be found. Just south-east of the Keeper's lodge is a single crack willow *Salix fragilis.* Only one specimen of silver birch *Betula pendula* remains, although there are several dead stumps. A hazel *Corylus avellana* occurs near the south boundary fence, but no others of this species are known even in surrounding areas.

Apart from elms *Ulmus* spp., which persist now only in the form of suckers, mainly around the edge of the wood, the remaining tree species have a generally more 'planted' appearance. The avenue of trees that runs from Wanstead Flats consists in Bush Wood of common lime *Tilia* × *europaea.* There are one or two limes elsewhere in the wood that are not part of the avenue. London plane *Platanus* × *hybrida* lines Bushwood roadside and part of Blake Hall Road. Here again specimens that are not part of the roadside plantings are present elsewhere in the wood. Also by Bushwood roadside is a yew *Taxus baccata,* the only one in the area.

Elder *Sambucus nigra* is quite common and widely scattered, often growing amongst the thickets of holly and hawthorn. In some parts bramble *Rubus fruticosus* agg., which is plentiful, assists the holly in making the wood difficult to walk through. The trees and bushes grow too thickly to allow much smaller plant-life, though the shade and damp encourage mosses, liverworts and fungi. These, however, are the subject of a separate study. Rosebay *Chamaenerion angustifolium* does grow well in the wood, as does bracken *Pteridium aquilinum,*

which is common. Male fern *Dryopteris filix-mas* is present but much less common. One other plant of interest is enchanter's nightshade *Circaea lutetiana* which grows in a large patch in the south-east corner. This is relatively uncommon in the neighbourhood outside Bush Wood except for some in neighbouring Wanstead Park, particularly in Reservoir Wood which is of a similar character to Bush Wood.

The open areas

The more open areas of the wood support generally common species of plants which may be found on grassland and disturbed land throughout the area, such as Oxford ragwort *Senecio squalidus,* yarrow *Achillea millefolium* and greater plantain *Plantago major.* The clearing in the centre of the wood does not contain many plants other than grasses, whereas the clearing running parallel to the tree avenue has nettle *Urtica dioica,* red clover *Trifolium pratense* and common catsear *Hypochoeris radicata,* as well as an abundance of creeping thistle *Cirsium arvense.* The open area in the north-west corner has a similar flora. The ditch and bank alongside Bushwood has something of its own plant community, including lesser burdock *Arctium minus,* common figwort *Scrophularia nodosa* and prickly lettuce *Lactuca serriola.*

The ponds

The dominant plant of the larger pond is soft rush *Juncus effusus,* which is often chewed and trampled by the cattle that may roam freely in the wood. Amongst the rush grows branched bur-reed *Sparganium erectum.* Particularly at the muddy west end of the pond redleg *Polygonum persicaria* is abundant, and amongst this marsh cudweed *Gnaphalium uliginosum* and many-seeded goosefoot *Chenopodium polyspermum* have been found. Bulbous rush *Juncus bulbosus* and heath rush *J. squarrosus* both occur very near the pond. The smaller 'pond' is a hollow filled predominantly with soft rush.

Although more species surely still remain to be discovered on Wanstead Flats and in Bush Wood, and the distribution, particularly of the grasses, needs further investigation, an overall impression gained during the survey was that of the 250 species recorded, many of these were few in number.

It was originally intended, in order to avoid lengthy lists of generally common plants, to omit those species that are also to be found in Wanstead Park. However, it was found that 93 species are to be found on Wanstead Flats and in Bush Wood that are not present in the Park, and 105 species in the Park that do not occur in the other area. It seems better, therefore, to append a complete list to this paper as well as to the previous one. This allows me to comment on species which might be falsely supposed to be common. Species known to have been recorded from Wanstead Flats in recent years, and not found during this survey, are heath grass *Sieglingia decumbens* and silky apera-grass *Apera spica-venti* (Jermyn 1975).

The sequence of plants in Table 1 follows the order and nomenclature of Clapham, Tutin and Warburg (1962). The letters and numerals after some of the entries refer to the squares shown in Fig. 1, each square being 0.25 x 0.25km. Plants found only in Bush Wood or in both Bush Wood and on Wanstead Flats are indicated; it should be assumed that other species in the list have been found only on Wanstead Flats.

Acknowledgments

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TABLE 1. Plants recorded from Wanstead Flats and Bush Wood during the years 1975 to 1979.

Abbreviations

Alex. Alexandra Lake
BW Bush Wood
COL City of London Cemetery
WF Wanstead Flats

PTERIDOPHYTA

Pteridium aquilinum bracken. BW. Common
Dryopteris filix-mas male fern. BW. Uncommon

GYMNOSPERMAE

Pinus nigra laricio Corsican pine. One tree only by Alex. L3.
Taxus baccata yew. BW. One tree by Bushwood Roadside, F7.

ANGIOSPERMAE: DICOTYLEDONES

Ranunculus acris meadow buttercup. BW and WF. Common in ditches and grassland.
R. repens creeping buttercup. BW and WF. Common in ditches and grassland.
R. bulbosus bulbous buttercup. BW and WF. Less common than the previous two species. In grassland.
R. sceleratus celery-leaved crowfoot. 'Marshy' areas only.
R. ficaria lesser celandine. Uncommon. F5, J5.
Nymphaea alba white water-lily. Alex., 1977, L3.
Ceratophyllum dimersum hornwort. Dames Road Pond. F3.
Papaver rhoeas common poppy. Uncommon.
P. dubium long-headed poppy. Rare. By roadsides.
P. somniferum opium poppy. BW and WF. Uncommon. By roadsides.
Brassica oleracea cabbage. BW and WF. Uncommon.
Diplotaxis tenuifolia wall rocket. Uncommon. In ditches.
Raphanus raphanistrum wild radish. Only by COL wall, M2.
Cardaria draba hoary cress. Locally common in patches in grassland and by roadsides, particularly in M1/2.
Thlaspi arvense common field pennycress. Only found in ditch, L2.
Capsella bursa-pastoris shepherd's purse. BW and WF. Common, and abundant beneath hawthorns in L/M2.
Lunaria annua honesty. Uncommon in roadside ditches.
Lobularia maritima sweet alison. One small plant on Capel Roadside bank in 1975, I1.
Cardamine hirsuta hairy bittercress. Uncommon. Capel Road ditch, M2 and back of Belgrave Road houses in F5.
Rorippa sylvestris creeping yellowcress. Rare. Has been found in Capel Road ditch.
Sisymbrium officinale hedge mustard. BW and WF. Common in ditches.
Viola sp. garden pansy. One plant in ditch, N2.
Hypericum perforatum perforate St. John's wort. By COL wall, M/N2.
Silene vulgaris bladder campion. Rare. G4.

S. dioica red campion. BW and WF. Uncommon.
S. alba white campion. Common in grassland.
Agrostemma githago corn-cockle. One plant on roadside bank, K2, 1977. Of garden origin.
Saponaria officinalis soapwort. Double-flowered forms sometimes occur by roadsides, e.g. N2. Single-flowered form also found, e.g. from grassland in G5.
Cerastium holosteoides common mouse-ear. Uncommon.
Stellaria media common chickweed. BW and WF. Common.
S. graminea lesser stitchwort. Uncommon. G2, H4.
Spergularia rubra sand spurrey. An extensive patch on a football pitch in I4. Rare elsewhere.
Chenopodium polyspermum many-seeded goosefoot. BW Only at the edge of BW pond, F7.
C. album fat-hen. BW and WF. Uncommon. Mostly in ditches.
Atriplex patula common orache. Uncommon. In roadside ditches.
A. hastata spear-leaved orache. BW and WF. Uncommon. In roadside ditches.
Tilia cordata small-leaved lime. A few scattered trees.
T. × europaea common lime. BW and WF. Common and widespread.
Malva sylvestris mallow. Uncommon.
Althaea rosea hollyhock. BW and WF. Uncommon. Mostly by roadsides.
Geranium dissectum cut-leaved cranesbill. One plant at east end of Long Wood in I4.
G. robertianum herb robert. BW and WF. One patch by Lake House Road, G5, and another by Long Wood, I4.
Ailanthus altissima tree of heaven. BW and WF. Saplings by COL wall, N2.
Acer pseudoplatanus sycamore. BW and WF. Common.
A. campestre field maple. BW and WF. Uncommon.
A. platanoides Norway maple. BW and WF. Uncommon.
Aesculus hippocastanum horse chestnut. BW and WF. Common.
A. × carnea red horse chestnut. One tree by Aldersbrook Road, J5.
Ilex aquifolium holly. BW and WF. Common in woods and copses.
Laburnum anagyroides common laburnum. One tree in G5.
Ulex europaeus gorse. Common.
Sarothamnus scoparius broom. BW and WF. Common. Particularly west of Centre Road and on Manor Park Flats.
Robinia pseudoacacia locust tree. BW and WF. Two trees near Bush Road in BW, F8, and a few trees in copses on WF.
Medicago lupulina black medic. Found in small patches over much of WF grassland.
Melilotus alba white melilot. One plant found at edge of Long Wood in 1977, H4.
Trifolium pratense red clover. BW and WF. Common.
T. repens white clover. BW and WF. Common, particularly on playing fields.
Lotus corniculatus birdsfoot trefoil. Common on playing fields.
Galega officinalis goat's rue. By Capel Roadside in J2, 1975.
Vicia cracca tufted vetch. BW and WF. Common in rough grassland.
V. sepium bush vetch. One plant by Centre Road in H5.
V. sativa common vetch. BW and WF. Common in rough grassland.
Lathyrus latifolius broad-leaved pea. Uncommon. G5, I4.
Rubus idaeus raspberry. BW and WF. Rare. Amongst brambles in F4.
R. fruticosus agg. bramble. BW and WF. Common and widespread.
Potentilla reptans creeping cinquefoil. Common on playing fields.
Rosa canina dog rose. Rare.
Prunus spinosa blackthorn. BW and WF. One bush near the spring in H5.
P. serrulata Japanese cherry. Some trees on Manor Park Flats.
Crataegus monogyna hawthorn. BW and WF. Common.
C. oxyacanthoides Midland hawthorn. BW and WF. Red-flowered varieties on Manor Park Flats and two others in K2 and L2.
Sorbus aucuparia rowan. BW. A few small trees scattered throughout the wood.
S. aria whitebeam. BW and WF. A few trees in F7 and G8 in BW. Two trees in copse on WF, J2.
Malus sp. apple. BW and WF. Some trees by Lake House Road in G4/5, and on Manor Park Flats in N1.
Platanus × hybrida London plane. BW and WF. Common.
Sedum reflexum reflexed stonecrop. One plant by Capel Roadside in L2.
Epilobium hirsutum great willowherb. BW and WF. Uncommon in roadside ditches.
E. montanum broad-leaved willowherb. Common in roadside ditches.
Chamaenerion angustifolium rosebay. BW and WF. Common.

Circaea lutetiana enchanter's nightshade. BW only, in G7.
Callitriche sp. water starwort. On mud, e.g. 'Cat and Dog' Pond in F3.
Hedera helix ivy. BW and WF. In wood by Alex., L3.
Anthriscus sylvestris cow parsley. BW and WF. Uncommon.
Smyrnium olusatrum alexanders. Beneath hawthorns by Lake House Road in G5.
Conopodium majus pignut. Rare. In grassland, I4.
Foeniculum vulgare fennel. One plant by Long Wood in H4.
Bryonia dioica white bryony. Uncommon. By COL wall in N2.
Mercurialis annua annual mercury. Rare. In roadside ditch, H1.
Euphorbia helioscopia sun spurge. Uncommon.
E. peplus petty spurge. BW and WF. Uncommon.
Polygonum aviculare knotgrass. BW and WF. Common.
P. persicaria redleg. BW and WF. Uncommon.
P. hydropiper water pepper. One plant found in a damp hollow of rough grassland in K2, 1975.
P. cuspidatum Japanese knotweed. By house fence in F5.
Rumex acetosella sheep's sorrel. BW and WF. Common in rough grassland.
R. crispus curled dock. Common.
R. obtusifolius broad-leaved dock. BW and WF. Uncommon.
Urtica dioica stinging nettle. BW and WF. Common.
Ulmus glabra wych elm. A few trees still survive in 1979.
U. procera English elm. BW and WF. Most mature trees now dead but suckers are abundant.
Betula pendula silver birch. BW and WF. Widespread, but many trees dead.
Alnus glutinosa alder. One tree in wood by Alex., L3.
Carpinus betulus hornbeam. BW and WF. Occurs in many woods and copses.
Corylus avellana hazel. BW. One tree only in G7.
Fagus sylvatica beech. BW and WF. Common in woods and copses.
Castanea sativa sweet chestnut. BW and WF. Uncommon. A few trees in BW, and also in copses on the central Flats, I2/3.
Quercus robur English oak. BW and WF. Common in woods and by roadsides.
Q. cerris Turkey oak. One tree by Alex., in L3, also in North Copse, I3 and two trees by Long Wood in H4.
Q. borealis red oak. Occurs in most woods and copses on WF. Most common in North Copse, I2/3 and East Copse, J2/3.
Populus canescens grey poplar. BW only, where common.
P. tremula aspen. One tree in H4.
P. × *canadensis* hybrid black poplar. A number of trees by roadsides, particularly Woodford Road in H3 and H4.
P. nigra 'italica' Lombardy poplar. One tree in F3, another in D4.
Salix fragilis crack willow. BW only, in G8. One tree.
S. caprea great sallow. Only on islands of Alex.
S. repens creeping willow. Rare. A patch in I3, another in K3.
Calluna vulgaris ling or heather. Rare. One small patch in K3.
Lysimachia vulgaris yellow loosestrife. Rare. Has been found in roadside ditches.
L. nummularia creeping jenny. One plant in Capel Roadside ditch, L2.
Buddleja davidii buddleia. A few plants near Lake House Road, and on Manor Park Flats in N1.
Fraxinus excelsior ash. BW and WF. Two trees by Capel Road in H1, one tree in J5.
Syringa vulgaris lilac. A single small tree on Manor Park Flats, G5.
Ligustrum ovalifolium Japanese privet. BW and WF. A short roadside hedge by Forest View Road in N1.
Vinca minor lesser periwinkle. One plant near Lake House Road, G5.
Myosotis sylvatica wood forget-me-not. In Capel Road ditch, K2. This may be an outcast garden form.
Convolvulus arvensis field bindweed. By COL wall in M/N2.
Calystegia sepium silvatica great bindweed. BW and WF. Uncommon. In Capel Roadside hedge and by Aldersbrook Road on Manor Park Flats.
Solanum dulcamara bittersweet. BW and WF. Common in hedges and undergrowth.
S. nigrum black nightshade. BW and WF. Rare In roadside ditches.
Linaria vulgaris common toadflax. Scattered patches, most common on western Flats in G4/5. Also in K2, N1 and N2.
Cymbalaria muralis ivy-leaved toadflax. One plant in ditch, J1.
Scrophularia nodosa common figwort. BW only, in ditch, F7.

Digitalis purpurea foxglove. BW and WF. Uncommon. In gorse patch in H4 and at rear of houses in F5.
Veronica chamaedrys germander speedwell. Rare. Only known in Centre Road ditch near Long Wood, H4.
V. hederifolia ivy-leaved speedwell. BW and WF. Increasingly common, patches in various parts of the Flats.
V. persica Buschaum's speedwell. Rare. By COL in N2.
Mentha spicata Spear-mint. Rare. A small patch by Lake House Road in G5.
Melissa officinalis balm. By house fence in F5.
Prunella vulgaris Self-heal. Rare. One or two plants only found on playing fields in K2.
Ballota nigra black horehound. BW and WF. Common by Capel Road-side.
Lamium amplexicaule henbit. Uncommon. Has been found in Capel Road ditch.
L. purpureum red dead-nettle. Common.
L. album white dead-nettle. BW and WF. Common, often in ditches.
L. maculatum spotted dead-nettle. BW and WF. Uncommon. At rear of houses in F5 and in wood by Alex., I 3.
Glechoma hederacea ground ivy. Uncommon. Has been found in Capel Road ditch.
Teucrium scorodonia wood-sage. Only known as a patch beneath trees at edge of BW in F6.
Plantago major greater plantain. BW and WF. Common.
P. lanceolata ribwort plantain. BW and WF. Common.
P. coronopus buckshorn plantain. Confined to bare gravelly tracks in G2/3 and H5.
Campanula rotundifolia harebell. Two patches on rough grass, H5 and L/M3.
Galium saxatile heath bedstraw. One small patch in 1953 plantation.
G. aparine cleavers. BW and WF. Common mainly in roadside ditches.
Sambucus nigra elder. BW and WF. Common in BW, and some scattered plants on Flats.
Lonicera periclymenum honeysuckle. One bush by Aldersbrook Road in I5.
Bidens tripartita trifid bur-marigold. BW and WF. Only by BW Pond-side and by Alex.
Senecio jacobaea common ragwort. Uncommon, though seems to be increasing. A few plants in rough grass in M2 and O1.
S. squalidus Oxford ragwort. BW and WF. Common by roadsides and on disturbed ground.
Gnaphalium uliginosum marsh cudweed. BW only, by pond-side, F7.
Conyza canadensis Canadian fleabane. Uncommon, in ditches.
Bellis perennis daisy. Common on playing fields.
Matricaria matricarioides pineapple weed. Uncommon, on bare patches.
Achillea millefolium yarrow. BW and WF. Common.
A. ptarmica sneezewort. Only in one area of western Flats in G4.
Chrysanthemum parthenium feverfew. Uncommon, on roadside banks.
C. leucanthemum ox-eye daisy. Rare. Near Dames Road Pond in G2.
C. vulgare tansy. One patch known, in H5.
Artemisia vulgaris mugwort. BW and WF. Uncommon, by roadsides.
A. absinthium wormwood. One plant in ditch in H1, another in H4.
Arctium minus lesser burdock. BW and WF. Scattered by roadsides. Plentiful in ditch in I1.
Cirsium vulgare spear thistle. BW and WF. Common.
C. arvense creeping thistle. BW and WF. Common.
Centaurea cyanus cornflower. By Aldersbrook Road-side, N2, in 1977.
C. nigra black knapweed. Uncommon. Most plentiful on a grassy bank near the spring in H4/5.
Lapsana communis nipplewort. BW and WF. Uncommon, on disturbed ground.
Hypochoeris radicata common catsear. BW and WF. Common.
Leontodon autumnalis autumn hawkbit. BW and WF. Common.
Tragopogon pratensis goatsbeard. BW and WF. Uncommon.
Lactuca serriola prickly lettuce. BW and WF. Uncommon.
Sonchus oleraceus smooth sow-thistle. BW and WF. Common in rough grassland.
Hieracium sp. leafy hawkweed. BW and WF. Uncommon.
H. pilosella mouse-ear hawkweed. Uncommon in patches in rough grassland.
Crepis vesicaria beaked hawksbeard. Uncommon.
C. capillaris smooth hawksbeard. Uncommon.
Taraxacum officinale agg. dandelion. BW and WF. Common.
T. laevigatum agg. lesser dandelion. Uncommon, but widely distributed.

ANGIOSPERMAE: MONOCOTYLEDONES

Elodea canadensis Canadian pond-weed. In Dames Road and Capel Road Ponds.
Potamogeton crispus curled pondweed. Abundant in Dames Road Pond.
Endymion non-scriptus bluebell. BW and WF. Uncommon.
E. hispanicus Spanish bluebell. One plant by Capel Road-side in K2, 1977.
Allium vineale crow garlic. Most common in 'Garlic Patch', H5, also on western Flats in G4/5. Seems to be spreading.
A. triquetrum three-cornered leek. By house fence in F4, 1979.
Juncus squarrosus heath rush. BW and WF. Uncommon in BW, but widely scattered across WF.
J. bufonius toad rush. Below spring in H4. More common in 'Cat and Dog' pond in F4.
J. effusus soft rush. BW and WF. The most common rush.
J. inflexus hard rush. Less common than the previous species.
J. articulatus jointed rush. Uncommon. In 'Cat and Dog' pond and below the spring in H5.
J. bulbosus bulbous rush. BW only, at the north edge of pond, F7.
Narcissus spp. narcissi. Uncommon. Probably outcast garden varieties scattered widely over the Flats, particularly west of Centre Road.
Galanthus nivalis snowdrop. A few flowers near Lake House Road probably originate from nearby houses.
Iris pseudacorus yellow flag-iris. In Alex.
Crocus spp. Various forms of crocus occur on WF, of garden origin. A purple spring-crocus established in grass in H5; a yellow spring-crocus by Capel Road-side in I1; a patch of autumn crocus in wood by Alex., in L3.
Sparganium erectum branched bur-reed. BW only, by pond in F7.
Eleocharis palustris common spike-rush. BW and WF. Capel Road Pond.
Carex hirta hairy sedge. In grass near Lake House Road, G5.
Molinia caerulea purple moor-grass. K2.
Sieglingia decumbens heath grass. BW. F7.
Glyceria fluitans floating sweet-grass. BW and WF. By Capel Road Pond.
G. maxima great water-grass. In 'marsh' below spring, H5.
Festuca pratensis meadow fescue.
F. rubra rubra red or creeping fescue. Common.
F. ovina sheep's fescue. BW and WF.
F. tenuifolia fine-leaved sheep's fescue. Uncommon.
Lolium perenne perennial rye-grass. BW and WF. Common.
Poa annua annual meadow-grass. BW and WF.
P. nemoralis wood meadow-grass. BW and WF.
P. pratensis smooth meadow-grass. BW and WF.
P. trivialis rough meadow-grass. BW and WF.
Dactylis glomerata cocksfoot. BW and WF. Common.
Cynosurus cristatus crested dogstail. BW and WF. Uncommon.
Zerna erecta upright broom. Roadside. L1.
Anisantha sterilis barren brome.
Bromus mollis soft brome.
Agropyron repens couch. BW and WF. Common.
Triticum aestivum bread wheat. In Capel Road ditch, I1, in 1979, probably from seed dumped there.
Hordeum distichon two-rowed barley. With previous species.
H. vulgare six-rowed barley. One plant by Capel Road, K2, in 1977.
H. murinum wall barley. BW and WF. Common, mostly by roadsides.
Trisetum flavescens yellow oat-grass. Uncommon.
Avena fatua wild oat. In Capel Road ditch, I1.
A. sativa common oat. With previous species.
Arrhenatherum elatius false oat-grass. BW and WF.
Holcus lanatus Yorkshire fog. BW and WF. Common.
H. mollis creeping soft-grass. BW and WF.
Deschampsia caespitosa tufted hair-grass. Common.
D. flexuosa wavy hair-grass. Some large patches.
Agrostis tenuis common bent. Abundant.
A. gigantea black bent.
A. stolonifera creeping bent.
Phleum pratense timothy. Common.

P. bertolonii smaller catstail.
Alopecurus pratensis meadow foxtail. BW and WF. Common.
A. geniculatus marsh foxtail. BW. F7.
Nardus stricta mat grass. BW and WF. Uncommon, but widespread.

Book Reviews

Sussex Plant Atlas: an Atlas of the Distribution of Wild Plants in Sussex. P. C. Hall. Brighton: Booth Museum of Natural History, 1980. £7.95.

The name of Peter Hall will be familiar to the older botanists in the London Natural History Society, of which he was for many years a sectional officer. It will also surely have caught the eye of students of British local floras issued in the last 30 years, writers of which from south England to north Scotland have reason to be grateful for his willingness to search remote or superficially unpromising places for plants both ordinary and rare. Those who know him may reasonably express surprise that he has never till now published any major contribution to botanical knowledge under his own name, and that the one under review should be concerned with Sussex, a county where he has never been resident.

He might argue that this is in any case not a major original work but an updating of Wolley-Dod's *Flora of Sussex* (1937), conceived years before the beginning of his own involvement and illustrated by maps compiled from data collected by a whole host of contributors over several years. Certainly there are tiresomely frequent comparisons with the abundance of species indicated by Wolley-Dod, but no mention whatever of the earlier flora of the county by Arnold (1887). Also, not all the text is his: there are an almost entirely superfluous foreword by Alison Ross, a note from Mary Briggs giving the history of the Sussex Flora Society which organised the collection of the records, and a meaty page by E. C. Wallace on the geology and topography of the county. Even ignoring these there is still a very substantial body of work deciding the format of the book, writing the rest of the introductory matter, getting the plants into sequence, doing the text for each and finally of course seeing it through the processes of book production, and it is not unfair that he should be judged on this.

The county of Sussex is very much more extensive from west to east than from south to north. To fit numbers of maps of the county on to pages of reasonable quantity and conventional shape it was plainly necessary to have them small and in double-column on the page. The effect of this has been to reduce the maps so much that the dots indicating a record are scarcely larger than the specks of dust which have also been photographically reproduced, like the one which appears to indicate *Cakile* growing 10 km from the sea in East Sussex. The maps call for close study in any case. The text accompanying them often adds little which cannot be inferred, especially as words such as 'occasional' and 'frequent' are used in a totally standardised way based on the percentage of the 1022 2 x 2 km squares into which the map is divided inhabited by the plant. The opportunity to give an assessment of the abundance of a plant within the squares where it grows, an assessment which would necessarily be subjective, is almost never taken. No maps at all are offered of species recorded in 90% or more of the county. This would be an unarguably sensible saving if the line had been drawn at 98%, allowing one to guess that species as common as that are truly ubiquitous and have been overlooked in 2% of their potential area in Sussex; but one tenth of it is a sizeable chunk of country, and one should be allowed to see just where these only relatively 'ubiquitous' species appear to be missing.

The major innovation in this book is that it follows the sequence and nomenclature of *Flora Europaea* (1964 – 80). The sequence will no doubt become familiar in time to British readers used to the rather different arrangement of Clapham *et al.* (1962). It ought not to present an immediate difficulty because plants can be located by the index. However to do so one may need to know the names used in *Flora Europaea*. The only synonyms consistently given are the names used by Wolley-Dod. To take an extreme case, the grass which is usually referred to in this country as *Catapodium rigidum* can be found easily if

one knows that *Flora Europaea* uses the older generic name *Desmazeria*. If one is old enough to remember that it used to be called *Festuca rigida* one can look up *Festuca* in the index and be referred, unhelpfully, to the page which has the grasses still considered to be *Festuca* species, or one can leaf through the pages of grasses until one finds *Festuca rigida* given as a synonym of *Desmazeria marina*, an unfortunate error having transposed two names on page 145. Alternatively one can reach it by its English name of Fern-grass. Dony *et al.* (1974) have been used with equal rigour as a source of standard names, which are indexed without any cross-references. 43 *Carex* species, spreading over six pages, are indexed separately only by their English names, so there is some advantage in knowing that Spring-sedge, to Fox-sedges and sundry others are spelt with a hyphen whereas Flea sedge, Pill sedge and Star sedge are not and can be found together. These are small points but important because they make it more difficult to extract the information from the mine provided by the maps. A local flora appears not to be the best place for such an innovation.

It can also be judged by the extent to which it draws on all available sources of records. *Seseli libanotis*, which Hall says is now known only from west of Cuckmere Haven, was certainly present on the edge of Eastbourne golf course in 1969 (Leslie 1970) and shown to many botanists then by one of his listed contributors, who also failed to report to him many interesting plants on the Crumbles still farther east, the rarest of them being *Eleocharis uniglumis*. It is also this reviewer's experience that a cooperative venture will only be successful to the extent that cooperation can be fully maintalned.

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Hedgerow. By Eric Thomas and John T. White. 46pp. Ash and Grant, London. £4.95.

Until recently the hedgerow was one of the most characteristic and enduring features of the British countryside — now, alas, agricultural and other changes have sadly left it a shadow of its former glory. The hedgerow described in this book reminds us of its past and cherished role in the economy of rural communities through Saxon, Tudor and Victorian times as a source of fuel, food, wine and a medicine chest as well as a stockproof barrier and even a means of defence. Today, however, the hedgerow's main value is as a haven for a wide variety of flora and fauna — an intricate and complex web of life developed over centuries. The hedgerow may be regarded as a measure of the rate of change in the British landscape since some disappear literally overnight; a sad end to part of our natural heritage which can never be replaced like so many of our wildlife habitats. This charming and attractively presented book deserves to be read widely by those who wish to conserve the hedgerow and also by those who destroy them so carelessly and often at whim.

SUSAN JOY

The Flora of Wisley and Ockham Commons, with Chatley Heath, Surrey

by A. C. LESLIE*

Summary

An account is given of the Flora of Wisley and Ockham Commons, together with Chatley Heath. The area still holds a number of native plants of local and national importance and a recent survey revealed a surprising range of established aliens.

Introduction

The area covered by this account is that of the Site of Special Scientific Interest for Wisley and Ockham Commons, together with Chatley Heath, which lie respectively in the parishes of Wisley, Ockham and Cobham, although effectively standing as one unit. It is bounded by Deer's Farm, Wisley and Wisley Lane in the west, Foxwarren Park in the north, Red Hill and Telegraph Hill in the east and by Hatchford End and Elm Corner in the south. At its northern angle it is exactly 20 miles from St Paul's Cathedral, London. It represents an area of roughly 2 x 2km and lies between the Rivers Mole and Wey, which come to within one mile of each other at this point. Bisected by the main London to Portsmouth road (the A3), it lies mainly on base-poor acid Bagshot Sands, except for the lower part of Wisley Common where this is overlain by river gravels. The ground rises from *c.*50ft (15m) above m.s.l. near the R. Wey to over 175ft (54m) on Telegraph Hill and the majority of the area drains across Wisley Common and into the Wey north-west of Buxton Wood.

The area contains both wet and dry heathland, although much of the drier ground is now wooded, a few small areas of alder carr along the various streams and a series of ponds, lakes and pools of varying botanical interest. It was thoroughly resurveyed as an S.S.S.I. during 1979 by the author, resulting in a remarkable tally of 513 species (and hybrids) and a number of interesting new records. Where these are additional to the records given by Lousley (1976) they are indicated as follows: *representing an addition to 05D5 and **an addition to 05E5. The area is covered by the Ordnance Survey 1:25,000 sheet TQ 05 on which all the localities mentioned will be found. Tetrad 05E5 is the 2 x 2km square in the top right hand corner, 05D5 that immediately to its west. An earlier survey covering part of the area under consideration was published by Simmonds and Cartwright (1910), with a supplement compiled by Bassett *et al.* (1912). It is clear that there has been some considerable reduction in diversity of both aquatic and heathland species.

For the purposes of this account the area is divided into five sections. Two lie to the north-west of the A3 and are divided by the track running down to Pond Farm; the area to the south-east of the main road is conveniently divided by the Hatchford End (Effingham) road. The immediate environs of the main road and the old Hut Hotel site make up the fifth section.

1. South-west of Pond Farm (the S.S.S.I. does not include the agricultural land, which is the site of a large, shallow, 18th century fish pond).

The southern end of this area is well wooded, chiefly with *Pinus sylvestris*, *Quercus robur* and the two lowland birches, but much of the northern half

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consists of open damp heathland, dominated by *Calluna vulgaris, Erica tetralix* and *Molinia caerulea,* although even this is under heavy invasion by young birch and stands of bracken. Where the stream descends on to the low-lying ground there is a large bog pool, now mostly overgrown with various *Juncus* spp., *Sparganium ramosum* and *Salix atrocinerea.* Nevertheless it is still of prime interest to the botanist as it has more than 50 tufts of *Deschampsia setacea* on its boggy margins and a little searching will also provide *Epilobium palustre, Cirsium dissectum* (now only 4 plants — formerly abundant), *Scirpus fluitans* and *Eleocharis multicaulis.* The bright orange-brown autumnal tints adopted by the *Eleocharis* are both attractive and characteristic. An interesting discovery here in 1979 was a quantity of **Pilularia globulifera,* well known about Boldermere, but not recorded on this side by Lousley (1976). However Bassett *et al.* do list it for Wisley Common so it has probably been here all the time!

A little further to the north are a few shallower bog pools and around one of these is an even larger population of the *Deschampsia,* which seems little affected by the serious fire that swept this area in the summer of 1976. There is also much *Veronica scutellata* (both the glabrous and the hairy forms) and *Scutellaria minor,* which is frequent in damp semi-shaded habitats all over the Commons.

Along the artificial drainage channel that runs between these two areas are at least three crowns of *Osmunda regalis.* Although there have been records of this in the Wisley area for many years, there is always a slight question mark over their status and certainly one other large clump, growing with *Lysichiton americanus* by the R.H.S. car park, is planted.

Damp trackways and cart-ruts on this part of the Common locally provide suitable ground for *Bidens tripartita, Drosera rotundifolia, *Scirpus setaceus* and **Lythrum portula,* the latter very close to being the subspecies *longidentata,* with epicalyx segments 1.5mm or more long. Here and there *Salix repens* still wends its way through the heathers, but earlier records of *Pedicularis palustris* can no longer be confirmed. On the other hand the great mass of rushes regenerating on the burnt ground have thrown up new records of some confusing varieties for the unwary, including **Juncus effusus* var. *compactus, *J. conglomeratus* var. *subuliflorus* and a luxuriant plant of *J. effusus* with spirally coiled leaves and stems. This is sometimes grown in gardens as the cultivar 'Spiralis' and it is apparently a genetic mutation which crops up from time to time in large populations. Equally noteworthy was a single plant of *Listera ovata* in a small copse on slightly raised ground to the west of the main bog pool; interestingly enough Simmonds and Cartwright (1910) also list it for Wisley Common.

On the drier parts of the heath are some extensive intermixed colonies of *Ulex europaeus* and *U. minor* together with some fine stands of the elegant **Genista anglica.* It is noticeable that the last two are restricted to those areas that have been least disturbed and it is sad to report that there is quite a list of plants of drier ground recorded by Simmonds and Cartwright that are no longer evident. These include *Nardus stricta, Achillea ptarmica, Campanula rotundifolia, Dianthus deltoides* and *Cuscuta epithymum.* The *Achillea* was described as 'fairly plentiful' on Wisley Common in 1910 but today it seems to have disappeared and only a single plant was seen on Ockham Common, along the verge of Poynters Lane; the others are entirely absent from the S.S.S.I.

Woody aliens are surprisingly numerous in this and other sections. Besides the ever increasing pine plantations there are the not uncommon *Rhododendron ponticum, Castanea sativa* and *Quercus cerris,* whilst a single large specimen of **Q. borealis* in the middle of this section is more unusual and has apparently been missed or ignored by previous recorders as it must be at least 80 years old!

Amelanchier lamarckii is established in a few places (though not regenerating much) and there is a flourishing and long-established colony of **Kalmia angustifolia* (Leslie 1979).

The wooded northern and western margins of this section are worth walking, both for their bramble flora and the fine old boundary oaks on the northern border. Starting at the northernmost tip with the vigorous **Rubus integribasis* and walking towards the south-west one passes **R. polyanthemus* and then *R. cissburiensis,* rampant below what is probably a clone of diseased elms. Further on is a fine colony of the attractive **R. formidabilis,* with its yellow-green foliage and bright pink flowers and a smaller one of the lanky *R. oxyanchus.* Reaching Wisley Lane near the old schoolhouse one meets the first *R. infestior* and further to the south the erect stems and plicate leaves of **R. plicatus.* Here too is a bush of *R. ulmifolius* which, though one of the most widespread and common species in the country, avoids the acid Commons and at Wisley is restricted to three isolated clumps all on ditchbanks, where the soil is likely to be less impoverished.

Also beneath the fringing birchwood in one place is a venerable corm of **Cyclamen hederifolium* (well established even if originally planted) and patches of **Lamium maculatum* as well as the odd *Rosa rugosa.* Nearer the A3 the dominant brambles include *R. surrejanus* (this and *R. cissburiensis* are the two most widespread and abundant species on the Commons) and **R. flexuosus.*

2. North-east of Pond Farm

The pond itself is botanically unproductive, but its boggy margins hold a few plants of local interest such as *Rhynchospora alba* and both *Drosera intermedia* and *D. rotundifolia.* Neither sundew now occurs to the south-east of the A3 and *D. intermedia* only locally in this section. *Carex pulicaris* was known here until very recently but despite several searches could not be found in 1979; however it is inconspicuous and could still have been missed. On the dry trackside bank of the pond is the only station for *Dactylorhiza fuchsii* within the S.S.S.I. boundaries.

The Common to the north-east of the pond is not quite so wet as in the first section, but nevertheless the drainage ditches and damp tracksides can boast populations of **Carex binervis, Scirpus cespitosus* and at least one more clump of *Osmunda.* This is as far east as the *Scirpus* comes in Surrey and this site represents an 'outlier' from its main concentration on the heathlands in the west (as it does also for *Drosera intermedia* and *Rhynchospora alba*).

The drier margins of this section are also rewarding. Below Foxwarren Park grow a number of plants which, though probably overspills from the estate, are now well established. **Hypericum androsaemum* in particular is quite abundant along one shady trackway and near the boundary are some fine flowering and fruiting patches of **Sasa palmata* var. *nebulosa;* this is in fact the usual form of this bamboo in cultivation, with dark-spotted stems. *Cotoneaster simonsii* and further *Amelanchier* also crop up on this side, whilst ***Gaultheria shallon* is quite luxuriant in woodland just to the west of Red Hill.

By contrast the area running immediately alongside the A3 north-east of Cockcrow Hill has some interesting dry turf. Here *Teesdalia nudicaulis* persists on one bank where it has been known for over 40 years and there are also hereabouts *Aphanes microcarpa, Sagina ciliata,* ***Galeopsis bifida* and good colonies of a Surrey rarity, *Viola canina.* The *Viola* grows here with *V. riviniana,* and some plants with an intermediate morphology and lacking swollen capsules are clearly **hybrids. A small patch of true *Potentilla anglica* (conf. B. A. Matfield) was recently all but removed by vehicle disturbance, but its hybrid with *P. erecta,*

**P. × suberecta* (also conf. B.A.M.), is still locally plentiful. Lousley (1976) lists no modern records for this latter combination, but is right to suggest that despite this it and other hybrids of this group are not infrequent on Surrey Commons. This seems the right sort of ground too for *Filago minima* and although given for both tetrads in the Flora there was no sign of it here or anywhere else!

The neighbouring scrub is notable not only for being the local headquarters of *Rubus pyramidalis* and in having the only bush of *R. vestitus*, but for the occurrence of *Viola hirta*, otherwise almost entirely restricted to the chalk range in Surrey. The record is noted by Lousley who believed it was associated with dumped chalk waste. Certainly it grows here with *Viola odorata*, *Brachypodium sylvaticum* (otherwise a rarity on the Commons) and ***Inula conyza*. Perhaps the *Thymus pulegioides* on the roadside here is of similar origin.

3. West of the Hatchford End road

Boldermere, sometimes known as the Hut Pond, is still the main attraction in this section, despite the encroachment of the road on one side, the growth of surrounding trees and shrubs, and the ever increasing pressure from fishermen, bathers, canoeists and picnickers.

Its most famous alien, *Calla palustris*, first recorded here over 100 years ago, languished without flowering during the early seventies and has not been seen at all in recent seasons. Nor has *Deschampsia setacea*, trampled out of existence on the eastern shore, or *Carex echinata*, seen here up till only a few years ago, which could not be found in 1979. On the credit side *Baldellia ranunculoides* survives and both *Pilularia globulifera* and *Littorella uniflora* are still locally abundant; all three are very local Surrey plants. *Hypericum elodes*, *Carex pseudocyperus* and *Hydrocotyle vulgaris* also flourish despite being trampled on and the *Carex vesicaria* noted by Simmonds and Cartwright (1910) is still growing at the edge of the lake near the main road.

Three great rafts of *Equisetum fluviatile* are forging out into the open water, though their recent progress must have received something of a setback as a result of the vigorous feeding amongst their roots by a huge wintering flock of Canada geese, whose numbers reached a maximum of 75 in early 1980. **Nymphaea alba* is also established opposite the Hut Hotel site although probably planted, but the three pondweeds are without doubt native, these being *Potamogeton natans*, *P. polygonifolius* and **P. obtusifolius*. At least two other aquatics, an *Elodea* and a *Myriophyllum* are present and at the moment remain specifically unidentified, but there is no doubt about the forest of slender stems of *Eleocharis acicularis* which appear annually in the sandy shallows on the roadside margin. Sadly there is no sign here or elsewhere of *Acorus calamus*, *Lemna gibba*, *Anagallis tenella*, *Scirpus lacustris* or *Oenanthe aquatica*, all of which were reported by Simmonds and Cartwright.

A drainage stream feeds the lake at the south-east corner, except during high summer, and on its muddy banks is a colony of *Ranunculus omiophyllus*, fluctuating in numbers from year to year and likely to benefit from the recent demise of some surrounding trees.

Cutting across from here to the track that marks the southern boundary of this section one finds it bordered by colonies of *Rubus echinatus* and **R. rufescens* (amongst others) and at the western end, where the Elm Corner road bends round by the old aerodrome entrance, there is a patch of *R. ahenifolius*, a dark violet-purple in winter, with narrow leaflets and strongly falcate prickles; it is only found in two spots on the Commons. Nearby on a roadside ditchbank are the only, but superbly grown plants, of **Dryopteris pseudomas*.

4. East of the Hatchford End road

Much of the central part of this section is dry, hilly, species-poor heathland and pine/birch/rhododendron woodland, with the result that most of the interest lies in the marginal areas. Poynters Lane on the north-east side is excellent bramble ground with at least 15 species and is the home of some luxuriant stands of *Agrimonia procera* and naturalized ***Lamiastrum galeobdolon,* in this case the silver-blotched form grown in gardens.

On Telegraph Hill stands a rare surviving link in the chain of semaphore towers between London and the coast. On brickwork at the base of the tower ***Soleirolia soleirolii* persists from earlier cultivation and in the surrounding clearing are various old fruit trees, a ***Philadelphus coronarius* and at least one huge filbert bush ***Corylus maxima.* The latter is distinguished from hazel *C. avellana* by the tubular involucre with a constriction just above the apex of the nut, which it exceeds. *Impatiens glandulifera* has a toe-hold just down the hill to the north of the tower and is likely to spread.

In the south of this section are two more shallow ponds. The eastern-most of these is completely overhung by trees and practically devoid of vegetation, but a little upstream in less gloomy woodland is a large mixed colony of *Dryopteris austriaca, D. filix-mas,* ***D. carthusiana* and *Athyrium filix-femina,* together with a *Calystegia* intermediate between *C. sepium* and *C. silvatica.* To the west of this pond are two tiny fields which provided a disproportionately large number of records, chiefly arable weeds such as *Raphanus raphanistrum, Gnaphalium uliginosum,* ***Lycopsis arvensis* and *Matricaria recutita* together with a solitary *Pyrus communis.* To the north-west of these fields on a continuation of their northern boundary bank is a lone individual of *Sorbus torminalis,* origin unknown.

The western of the two ponds has also become very silted and overgrown with willows and *Typha latifolia* in recent years. *Osmunda, Anagallis tenella* and *Drosera intermedia* can no longer be found but there is a solitary individual of **Ranunculus lingua* and a crowfoot, apparently *R. peltatus,* growing in the remaining open water. Nearby roadsides sport very fine plants of *Epipactis helleborine* and in a clearing on the hill above are the only plants of ***Myosotis discolor* noted within the S.S.S.I.

5. The Hut Hotel site and the A3 roadverges

The dualling of the A3 carriageway about 1976/77 disturbed a good deal of ground, bringing dormant buried seed to the surface and no doubt at the same time introducing others with imported soil. The result has been an astonishing range of plants scattered along the whole length of this section, not just a cluster around one obvious source of introduction. That the R.H.S. Garden nearby might have been the origin of some of the garden aliens is hard to rule out entirely, but their waste is kept within the system and cannot be readily held to account for such as the lone clump of **Achillea filipendulina* at the Wisley Lane end.

Some of the plants may be native here, as for example **Apera spica-venti* and **Malva moschata,* both now established in half a dozen places, or **Trifolium striatum* on one sandy bank alongside Boldermere. Both the *Malva* and *Trifolium* were on Simmonds and Cartwright's (1910) list, as was *Jasione montana,* described at that time as 'fairly frequent'. Today there is only a single plant on the central reservation opposite the Hut Hotel site. Others such as **Potentilla recta,* **Alcea rosea* and */***Bromus carinatus* are clearly aliens, but are the sort of

plants that could well become established, whilst **Descurainia sophia*, **Hyoscyamus niger*, **Carum carvi* and **Consolida ambigua* are by nature more transient and less likely to persist unless the ground is re-disturbed.

In striking contrast to these plants of dry sandy soils a small patch in front of the Hut Hotel site yielded a good selection of aquatics, including **Rumex hydrolapathum* and *Scutellaria galericulata*, both otherwise unknown within this immediate area. Even more startling were the 30–40 plants of **Polygonum minus* growing with them. Lousley (1976) lists it for only four Surrey tetrads and although one could also add further localities in wet meadows near the R. Wey at Send, the source of this material remains an intriguing mystery.

Mahonia aquifolium, *Syringa vulgaris* and *Ligustrum ovalifolium* are some of the woody aliens persisting around the Hut Hotel site and amongst the herbaceous denizens are **Rubus procerus*, **Oxalis europaea* and **Antirrhinum majus*. **Lychnis coronaria* has already begun to sow itself around and *Montia perfoliata* is abundant on and around old dry brickwork on the north-east side.

This leaves one last and rather remarkable record for this section, **/*****Vulpia ambigua*, which is firmly entrenched on the verge north-east of Cockcrow Hill, chiefly on the north-west side of the London-bound carriageway, sparingly on the south-east side and more rarely still on the sandy ride a little to the south-west. Its only other Surrey station is on similar sandy roadside banks by Great Frensham Pond, where it is still abundant. According to C. A. Stace (*in litt.* 1979) this typically maritime species has been spreading inland on the Greensand of Kent during the past few years and it may well be lurking on other sandy commons in Surrey. To make it more difficult to spot it grows here intermixed with *V. bromoides* and there is *V. myuros* not far away. On close examination it is told by the often broken and truncate tip of the upper glume and the numerous sterile apical florets in each spikelet.

The S.S.S.I. is due to suffer a further major upheavel in 1980 when the M25 is pushed across the northern part, with an interchange to the A3 at Redhill Bottom. This will clearly remove the *Viola canina*, *Potentilla anglica* and most of the *Vulpia ambigua*, but perhaps the disturbance will turn up as many as it destroys; one can only wait and see. One positive and optimistic fact that emerges from this survey is that new and exciting records can still be made in areas close to London, in reputedly one of the best botanized counties in the land.

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A Study of Plants as Indicators of Photochemical Pollution in the London Area

by DAVID J. BALL*

Summary

The formation and occurrence of photochemical pollution in the London Area is described. Concentrations of photochemically produced ozone are found to be sometimes comparable to those experienced on the east coast of the USA where considerable damage to vegetation has been reported. A study of the use of exotic plants, of known or suspected ozone-sensitivity, as indicators of photochemical pollution in the London area is described. A *Nicotiana* variety, grown at several locations in London during 1979, showed symptoms analogous to ozone-induced leaf damage. However, the degree of damage following pollution episodes did not correlate simply with their severity, as assessed by air pollution measurements made with the physico-chemical monitoring equipment of the GLC. Examination of the results suggest that, while these plants are sensitive to the concentrations of photochemically-generated ozone found in London, their sensitivity to this pollutant may be much reduced after first exposure. An alternative indicator species, *Ipomaea,* was used in 1980. At the time of writing the results, due largely to the unfavourable weather, are inconclusive. However, on the strength of works published for other of the world's cities it is considered that there remains scope for further investigation.

Introduction

The technique of using plants as indicators of air pollution is well established. For example, lichen surveys have been made of many of Britain's conurbations at one time or another with at least the partial objective of determining the extent and degree of pollution by sulphur dioxide, to which these plants are susceptible (Hawksworth & Rose 1970). However, although there is still cause for concern about the concentrations of 'traditional' pollutants such as sulphur dioxide and smoke in Britain's cities, particularly London, a measure of attention is now being paid to other pollutants, some of which have not previously been associated with this city. This changing awareness is attributable to a number of factors:

1. Smoke control of stationary sources in Britain is, in many areas, almost complete.
2. The availability of natural gas for combustion, with its low sulphur content, has contributed to a diminution of sulphur dioxide emissions, especially from domestic sources.
3. Changing activities, especially in the industrial and transportation spheres, have resulted in the emissions of many new pollutants, and greater quantities of other pollutants formerly judged to form concentrations too low to be of concern.
4. More information is now available on the health, vegetation and material damage effects caused by a much wider range of pollutants.
5. Techniques are available for monitoring a wider range of environmental pollutants than before.

One group of atmospheric pollutants which has begun to attract considerable attention in western Europe during the last decade, and which has been regularly monitored in London, is the photochemical group. This group comprises ozone, peroxyacetylnitrate (PAN), sulphates, nitrates and various other compounds, all of which are formed by chemical reactions in the atmosphere in the presence of sunlight which provides a necessary stimulus.

These pollutants have been known of for many years in the USA, particularly southern California, where they are the main constituents of 'Los Angeles smog'.

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They are known to have adverse effects on human health, vegetation and materials and to contribute to the formation of visibility-reducing aerosols.

To date, measured peak concentrations of photochemical pollutants in Britain and western Europe do not normally exceed one half to one third of those found in Southern California. However, they are on occasions comparable with concentrations found on the east coast of the USA where considerable economic losses to cash crops have been attributed to these pollutants. At the concentrations found in Britain it may be true that the most detectable effects of photochemical pollutants will be on vegetation. Whether or not these effects are likely to be of economic consequence for cash crops, or determinants of the viability of natural flora, remains to be seen.

Objectives

An essential ingredient of any pollution investigation programme is monitoring. In the case of photochemical pollution it is usual to monitor one or other of the reaction end-products such as ozone, PAN, or even the aerosol content of the atmosphere. This is because these are the easiest to monitor, and not necessarily because they are the most toxic. For example, some free-radical intermediaries may be more important in this respect, although they present formidable problems for the chemical analyst.

Even in the case of ozone, the most widely monitored photochemical pollutant, the cost of instrumentation is considerable (about £3,000 in 1980). However, it has been suggested that certain sensitive plants which develop visible signs of damage upon exposure to photochemical pollution may serve as useful indicators (see, for example, Bell and Cox 1975; Nouchi and Aoki 1979) which have the added virtue of being inexpensive. There is also the advantage that indicator plants, having a life-cycle broadly similar to that of other vegetation, may be the best monitors in a situation where effects on vegetation are sought.

The main objective of this project has thus been to investigate the possibility of using such an indicator plant locally in the London area. Various plants have been used as ozone indicators, including morning glory (*Ipomaea*) and certain varieties of tobacco. The first one used for this project was a tobacco variety, *Nicotiana tabacum*. Several groups of these plants were grown at various locations in London during the summer of 1979 and signs of ozone-induced damage correlated against ozone concentrations, as recorded by the Greater London Council (GLC) using their physico-chemical monitoring equipment. In this way it was intended to evaluate some aspects of the use of plants as ozone/photochemical indicators.

As a follow-up, a second series of measurements on two morning glory varieties was commenced in 1980. These plants, unlike *Nicotiana,* have the advantage of being readily obtainable in the UK.

Photochemical Pollution in the London Area

Although the existence of photochemical pollution had been known for many years in association with such cities as Los Angeles, the discovery of unnatural ozone concentrations in London in 1972 (Derwent and Stewart 1973) — an indicator of photochemical activity — came as somewhat of a surprise. This was because the main requirements for the formation of photochemical pollution are:-

1 Ample sources of precursor pollutants (oxides of nitrogen and hydrocarbons).
2 Adequate sunlight.
3 A stagnant atmosphere to inhibit dispersion of pollutants.

Prior to 1972 it had been intimated that none of these conditions existed in the UK. This was entirely incorrect, and recently a number of monitoring programmes have been carried out which demonstrate the truth of the matter. The main findings of these will now be described, following an outline of the mechanism of photochemical pollution formation.

The Formation Mechanism

Photochemical pollution, unlike the traditional London smog, is not emitted directly into the atmosphere from local sources. Instead it forms in the atmosphere by a complex series of chemical reactions between primary (or 'precursor') pollutants and atmospheric gases, in the presence of the ultra violet component of sunlight. The precursor pollutants are the oxides of nitrogen, both nitric oxide (NO) and nitrogen dioxide (NO_2), and hydrocarbons. NO and NO_2 are formed from the combination of atmospheric oxygen and nitrogen in the presence of a flame, and hence originate from such sources as space heating appliances and motor vehicles. For London it has been estimated that 54% of the NO_x emissions arise from transport, 7% from domestic sources, and 39% from commercial or industrial heating or steam raising appliances (Ball and Bernard 1978). Hydrocarbons are predominantly emitted by motor vehicles, with small contributions from space heating, solvent evaporation, and some industrial processes. Although the full reaction sequence has yet to be determined, the basic reactions have been known for some time, and are as follows:-

$$NO_2 + \text{UV photon} \rightarrow NO + \mathring{O} \quad (a)$$

$$\mathring{O} + O_2 \rightarrow O_3 \quad (b)$$

$$O_3 + NO \rightarrow NO_2 + O_2 \quad (c)$$

In reaction (a) the NO_2 molecule is dissociated by a quantum of UV light to yield a free oxygen atom. This rapidly combines with atmospheric oxygen to form an ozone molecule (b) — one of the main constituents of photochemical pollution. The ozone is rapidly destroyed in the presence of NO(c). Of course, these three reactions do not lead to any accumulation of ozone or other photochemical products on their own. However, the NO to NO_2 conversion reaction (c) also comes about via a complex reaction sequence involving the hydrocarbon pollutants. This results in a net accumulation of ozone as well as other noxious hydrocarbon radicals and products such as peroxyacetylnitrate (PAN) and visibility-limiting aerosols. The details of these reactions are a subject in themselves, and will not be pursued here. For the purpose of this report it is sufficient to have an overview of the atmospheric chemistry involved, as summarised in Fig. 1.

Although several of the photochemical reaction end-products have been monitored in London at one time or another since investigations began in 1972, that most frequently measured is ozone. Ozone concentration data are widely used as indicators of the degree of photochemical activity.

The Natural Ozone Content of the Troposphere

Before discussing the results of the various monitoring programmes which have been carried out in and around Greater London, it is necessary to be familiar with features of the diurnal variation of natural ozone at the earth's surface. Since the earth is surrounded by an ozone-rich layer in the stratosphere, it is to be expected that some of this will be transported downward to the earth's surface by atmospheric turbulence. Once at the surface it is destroyed by contact with it, or with particulate matter in the atmosphere, or by chemical reaction with ozone scavengers such as NO. Thus, even in a totally unpolluted area, a background

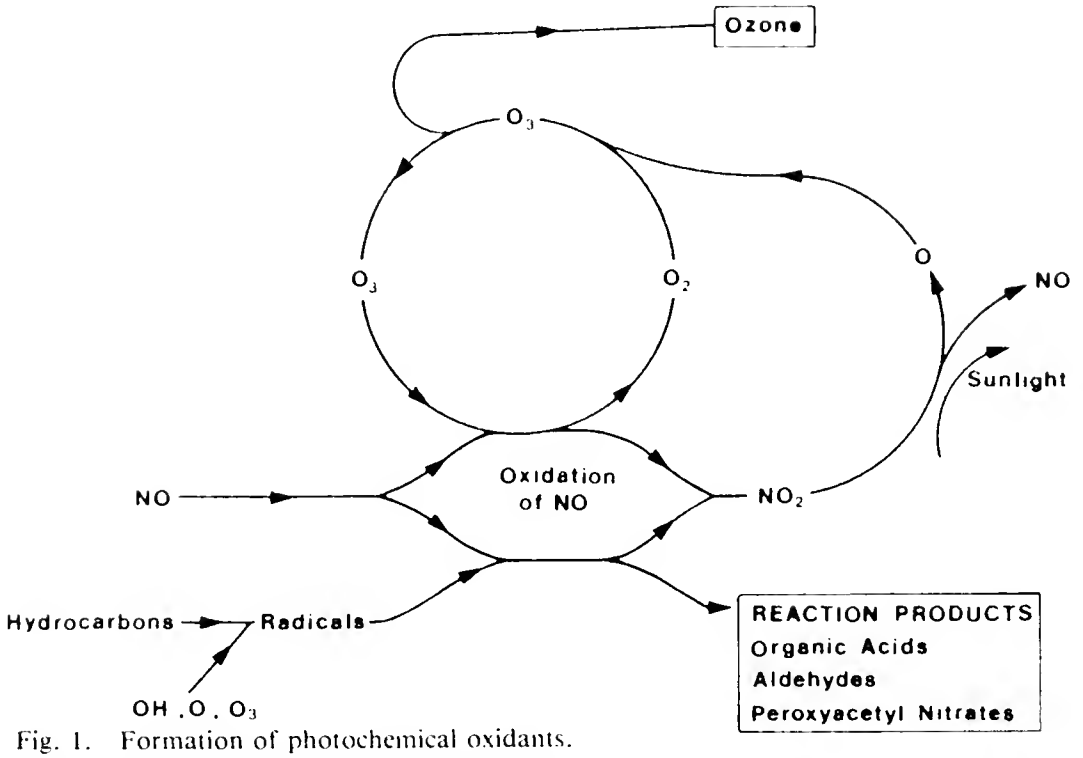

Fig. 1. Formation of photochemical oxidants.

concentration of ozone is to be expected. Under most normal circumstances this concentration varies through the 24h period, reaching a maximum of from .02 to .04 ppm during the afternoon. The main reason for the diurnal variation is that atmospheric turbulence close to the ground tends to be at a maximum during the afternoon, and at a minimum overnight — especially during a cloudless night when a temperature inversion may reduce the downward ozone flux to zero.

Ozone concentrations of .02 to .04 ppm are not thought to present a hazard to man or the environment. However, the threshold for effects is normally considered to be not much higher, and in the range of .06 to .12 ppm, where this is exceeded for 1h or more. This report will use the GLC's guideline value of .08 ppm (1h average) (GLC 1975) as a reference figure. Concentrations of this magnitude, except under very unusual circumstances, are only attainable in the presence of photochemical reactions arising from man's activities.

Yearly Variations in the Degree of Photochemical Activity

The first systematic measurements of ambient ozone concentrations in the UK were made at Harwell, Oxfordshire, in 1971 when levels of up to .10 ppm were recorded (Atkins *et al.* 1972). Since Harwell is a rural area, well away from precursor sources, measurements were carried out in London instead the following year at a site in Endell Street, W.C.2. The highest hourly mean concentration was found to be 0.13 ppm that summer (Derwent and Stewart 1973), with the .08 ppm guideline being exceeded on 15 of the 90 days on which monitoring was carried out. Monitoring at Endell Street continued during 1973 and 1974 with similar incidences of photochemical activity being recorded. In 1975 and 1976 a more extensive monitoring campaign with three sites was carried out in London by the GLC to shed further light on the situation (Ball 1976; Ball and Bernard 1978). Ozone concentrations recorded during the unusual summer of 1976 were, and still are, the highest on record for the UK. In London these reached 0.2 ppm, while 0.25 ppm was recorded down-wind. Further ozone monitoring has been carried out at one or more GLC sites in London since that summer.

TABLE 1. Ozone concentrations in Greater London, 1972 – 78.

Period of measurement	*1 Jul. – 30 Sept. 1972*	*1 Apr. – 30 Sept. 1973*	*1 Apr. – 30 Sept. 1974*	*1 May – 30 Sept. 1975*	*11 May – 30 Sept. 1976*	*29 Apr. – 30 Sept. 1977*	*5 May – 17 Sept. 1978*
Site	Endell Street	Endell Street	Endell Street	County Hall	County Hall	County Hall	County Hall
No. of days on which .08 ppm was exceeded	15	28	14	15	26	1	1
No. of hours above .08 ppm	40	124	55	87	148	3	3
Maxm. hrly mean recorded (ppm)	0.13	0.14	0.16	0.15	0.21	0.09	0.10

Table 1 gives an overview of the degree of photochemical pollution in central London each year from 1972 – 78, as indicated by ozone concentrations. These data show a marked variation in the degree of photochemical activity from year to year which has been attributed to seasonal fluctuations in anticyclonic activity (Ball and Bernard 1978). That a correlation should exist between anticyclonic activity and photochemical pollution is reasonable, as anticyclones tend to mean clear skies, hence favouring the formation of nocturnal temperature inversions and stagnant atmospheres, as well as unimpeded solar radiation during daytime.

The Diurnal Variation of Photochemical Ozone

Photochemically generated ozone often exhibits a strong diurnal variation. Like natural ozone, maximum concentrations tend to occur in the early hours of the afternoon. However, the factors determining the time of occurrence of peak concentrations are different and more complex. They include the time of release of precursor pollutants — in urban areas this may be associated with the early-morning rush-hour traffic; the time of maximum solar irradiation — about 1200h

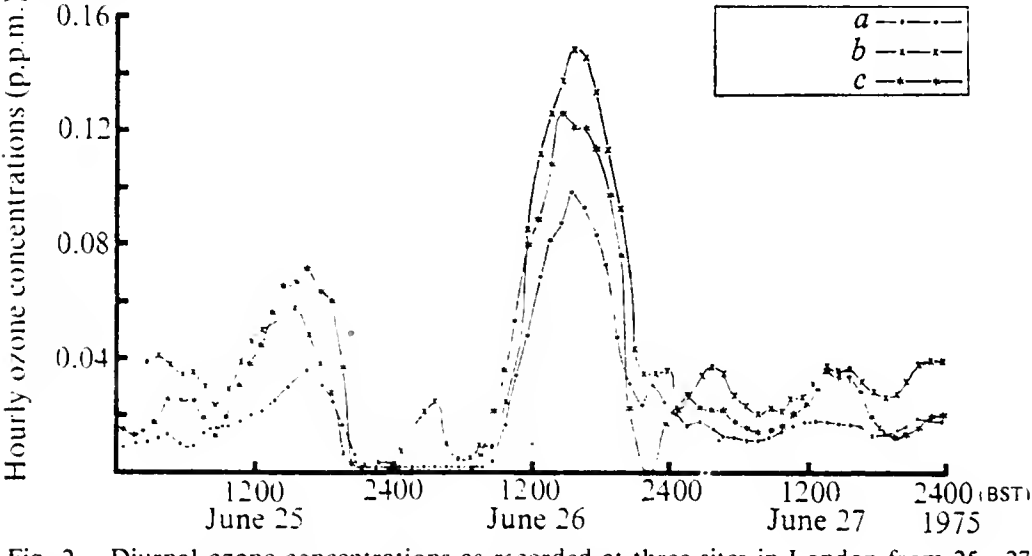

Fig. 2. Diurnal ozone concentrations as recorded at three sites in London from 25 – 27 June, 1975; a, Hainault; b, County Hall; c, Teddington.

local time; and the incubation period required for the formation of photochemical end-products — usually taken to be 1 – 2h. Thus, in the case of classical Los Angeles smog, peak ozone concentrations in downtown Los Angeles usually occur between 1200h and 1400h PST. Downwind of Los Angeles the maximum concentration may be recorded at later times due to the time of transit of the polluted air mass.

Fig. 2 illustrates the diurnal variation of ozone at three sites in London during an incident in 1975 (Ball 1976). Here ozone concentrations can be seen to be close to background at night but, on 25 and 26 June, increasing to greater than background levels during the early afternoon. The key factor in the incident of 26 June is thought to be the development of a strong nocturnal inversion which persisted into the early morning hours, and caused a build-up of locally emitted precursor pollutants (NO_x and HC).

Daily Ozone Maxima in London

A useful parameter for assessing the degree of photochemical pollution on a particular day is the maximum hourly mean ozone concentration. Fig. 3 displays these values for the three GLC sites operated during 1975. The location of these and other relevant sites is shown in Fig. 4. An examination of Fig. 3 shows that during this summer there were a number of occurrences of elevated ozone concentrations which were superimposed on a background concentration of from .02 to .04 ppm. Another feature is that isolated occurrences of high ozone concentrations, as on 26 June 1975, were uncommon. Generally, days with high ozone concentrations tend not to occur singly, but over periods of several days or more. A study of the appropriate Daily Weather Reports shows that on all days with high oxidant levels the synoptic conditions were dominated by slow moving anticyclonic cells and/or weak synoptic pressure gradients. As discussed earlier, anticyclonic conditions are generally characterised by light winds or calm conditions with clear skies, both of which are conducive to photochemical activity. Because anticyclones are slow moving the conditions tend to persist for days at a time.

Interpretation of the Monitoring Data

Some controversy has surrounded the interpretation of ozone monitoring data in the UK, particularly with respect to the origin of the responsible precursor pollutants. Some theories have favoured the transport of either precursor pollutants, or photochemical end-products into the UK from continental sources. Another has suggested that precursor pollutants from Europe as a whole form one giant cloud which, when irradiated, forms oxidants, while other evidence supports the idea that there is a detectable contribution to ozone concentrations in Britain which arises from locally emitted precursor pollutants. An early study of great interest was carried out by UKAEA Harwell and others (Cox *et al.* 1975) which reported ozone measurements from three sites in Britain and Ireland during 1973. The sites were widely spaced along a roughly E. – W. line across S. England and Eire, and were at Adrigole in S.W. Eire, Harwell in Oxfordshire and Sibton on the Suffolk coast. All were remote from local sources of precursors. Surprisingly, it was found that the .08 ppm guideline was exceeded on approximately the same number of days during the monitoring period at all sites despite the huge distance of the Adrigole site from any conceivable source of significant precursor emissions. In addition, many of the photochemical episodes occurred during periods of easterly winds when elevated ozone concentrations at Sibton could only be explained by advection from continental sources. It was stated that it was not possible to identify any specific contribution from UK sources with the data obtained.

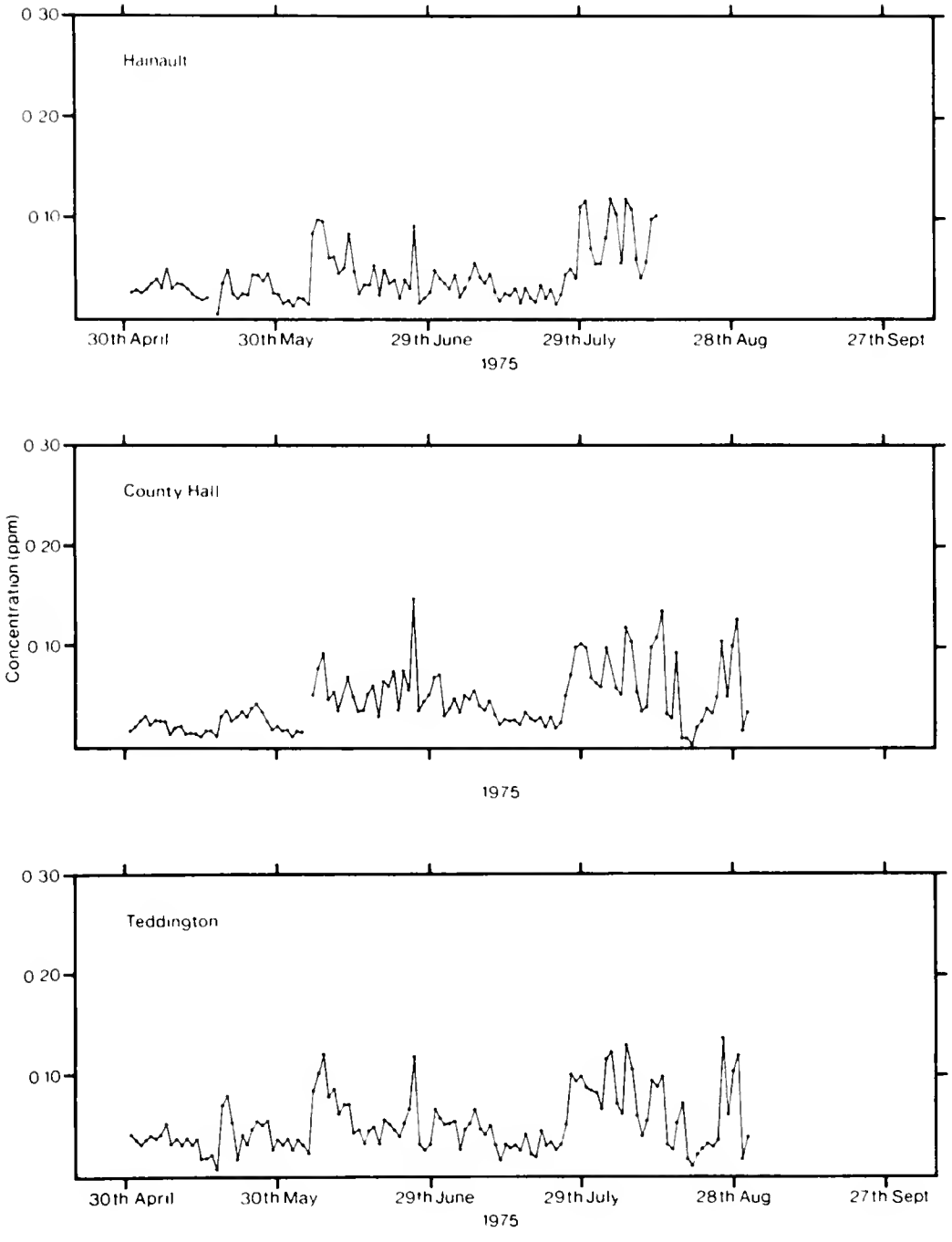

Fig. 3. Maximum one hour mean ozone concentration for each day during the summer of 1975.

Further insight was obtained, however, when the 1976 ozone monitoring data obtained by the GLC for the London area were analysed (Ball and Bernard 1978). What emerged was that there was a difference in ozone concentrations for air masses entering and leaving the Greater London area, with the higher concentration being consistently found at the downwind site. This provided strong evidence that the Greater London conurbation constitutes an identifiable source of photochemical pollution.

Summary of Current Knowledge on Photochemical Pollution in S.E. England

1. Contrary to earlier ideas, photochemical pollution is far from uncommon in S.E. England. In retrospect, this is perhaps not surprising, as precursor emission densities from traffic in the London area must be comparable with Los Angeles or, for that matter, any other major city. Secondly, peak sunlight intensity at London's latitude is only about 10% less than for Los Angeles. Thirdly, stable atmospheres, resulting from nocturnal inversions, are relatively common.

2. S.E. England is subject to locally formed photochemical pollution originating mainly from the dense precursor emission area of London, *and* to photochemical pollution transported by winds from more distant sources. The latter may include towns which are further afield. On rare occasions even continental sources may be implicated.

3. Because photochemical pollution can be transported substantial distances by winds, all areas of S.E. England and further afield are affected at one time or another. Indeed, concentrations of ozone are often higher in rural areas downwind of cities.

4. Because photochemical reactions are driven by sunlight, the highest concentrations are to be expected during the period May to September.

The Effect of Photochemical Pollution on Plants

The discussions in this section are confined to the effects of ozone upon plants. While information on damage by other photochemical pollutants such as PAN exists, (e.g. Mudd and Koslowski 1975, Thompson and Kats 1975) it is regarded by many as speculative.

Ozone Injury to Vegetation

It is difficult to write a general account at the biochemical level of the mechanisms of ozone injury to green plants because there is no consensus on any mechanism at this time. Many data now exist in the literature regarding ozone-induced metabolic changes in plants, but no consistent relationship has been conclusively established. Nonetheless, plants in general seem to be more readily injured than humans by ozone. At the macroscopic level this may by explained by the closer proximity of their sensitive tissues to ambient air. Following this line of approach, what is considered to happen is that the pollutant penetrates the foliage via the stomatal pores where it attacks some component of the palisade cells which subsequently collapse and dry out, forming areas of dead tissue (Heath 1975). These usually become visible to the naked eye as bleached necrotic lesions, forming a stipple pattern on the upper surface of the leaf. However, other symptoms have been observed, including brown necroses, bronzing of leaves, interveinal necrotic streaks, reddish pigmentation of leaves, and tip-burn on conifer needles (Hill *et al.* 1970).

In searching for and identifying effects of photochemical or other pollutants a number of factors need to be borne in mind (Mudd and Kozlowski 1975). Firstly, there is often a considerable variation in sensitivity even between varieties of one species. Secondly, the response to ozone of a given plant is likely to be modified by factors which control the opening of stomata, such as humidity, light intensity and soil moisture content. Thirdly, the dose-response relationship of a plant may not be a simple function of ozone concentration. Fourthly, the presence of other pollutants simultaneously may complicate the plant response, either inhibiting or exacerbating it.

Consequently, the task of identifying ozone damage in the field is complex, and many instances of reported damage may have been incorrectly attributed to oxidants, and many others may have been overlooked. Even more fraught with difficulties are economic assessments of oxidant damage to crops, and the assessment of the validity of such studies would fall beyond the scope of this article. Nonetheless, there are examples where oxidant damage has had an unequivocable effect on the economics of an area. One is the Los Angeles valley where there is substantial evidence that the sharp decline in citrus growing is at least partly attributable to photochemical oxidant damage, as is the extensive damage to Ponderosa pine *Pinus ponderosa* and Jeffrey pine *Pinus jeffreyi* in the nearby San Bernadino National Forest (Wert 1969). Many other plant species have been reported in the USA as showing evidence of ozone damage in the field. A list of those most frequently reported as being affected has been made by Bell (1978), and includes tobacco *Nicotiana tabacum*, tomato *Lycopersicon esculentum*, potato *Solanum tuberosum*, spinach *Spinacia oleracea*, dwarf bean *Phaseolus vulgaris*, maize *Zea mays*, eastern white pine *Pinus strobus*, grape *Vitis vinifera*, radish *Raphanus sativus*, and petunia *Petunia hybrida*.

Studies of Ozone Damage to Vegetation in Britain

Up to the present time there have been no conclusive reports of ozone-induced injury to crops or natural vegetation in the UK. However, as no consideration has been given to this possibility until recently, it would be wrong to discount it at this stage, especially as ozone concentrations in some summers are comparable to those in the Eastern USA where damage has been reported on a variety of crop species. Indeed, Ashmore *et al.* (1980a) have recently identified ozone-like foliar injury on *Pisum sativum* and *Raphanus sativus* grown in special chambers, but fed with ambient air, at Ascot.

Concerning the use of ozone-sensitive indicator species, a number of experiments have been carried out by research workers in the Department of Botany of Imperial College. During 1972 three differentially ozone-susceptible *Nicotiana tabacum* varieties were employed as ozone-indicator plants at Imperial College Field Station near Ascot (32 km West of Central London) (Bell and Cox 1975). The three varieties were Bel-W3 (supersensitive), Bel-B (resistant) and Bel-C (intermediate). Four individuals of each variety were exposed to ambient air, and a weekly record kept of the percentage leaf area damaged. Ozone concentrations were monitored during the experiment, and a relationship between the number of hours when the ozone concentration exceeded .04 ppm and the mean leaf damage produced on each variety during the period between measurements was sought. Little or no injury was found on the Bel-B or Bel-C plants. The Bel-W3 plants often displayed white or pale brown interfacial necroses, the area of which showed a positive correlation with the period of time for which ozone concentrations exceeded .04 ppm.

This work led to the use of Bel-W3 as an ozone indicator species in a national survey of photochemical pollution (Ashmore *et al.* 1978, 1980b). During the summer of 1977 batches of 6 plants were exposed at 53 sites throughout the British Isles and the percentage of leaf injury recorded at weekly intervals. During this 1977 study the amount of injury was found to be highest in areas such as North Wales and the central valley of Scotland rather than the more industrial Midlands and South-east England. An explanation for this was offered on the basis of the distribution of sunshine during the summer. It was found that there was a significant correlation between areas with the highest amounts of leaf injury and those receiving the most sunshine. This is consistent with the view of photochemical pollution outlined earlier, namely that high precursor emissions alone are not a sufficient criterion. Adequate solar radiation, the driving force, is also necessary for photochemical activity. The results of the study also indicated

that towns with populations as small as 5 to 10 x 10^4 could produce ozone concentrations up to .04 ppm.

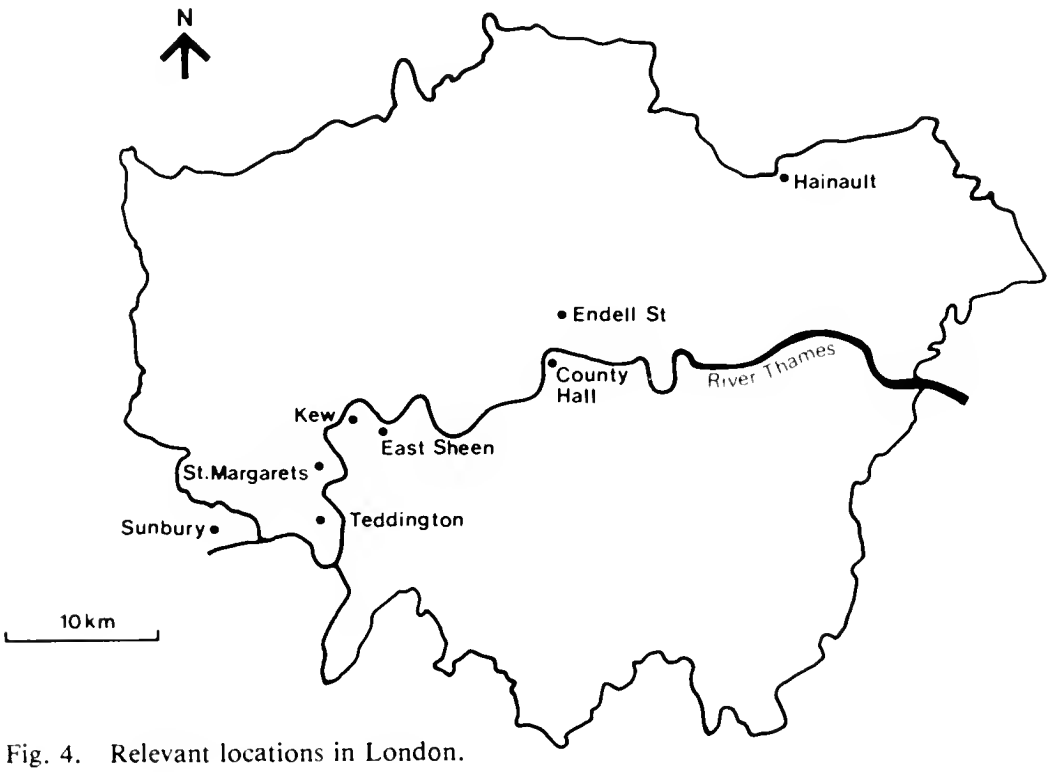

Fig. 4. Relevant locations in London.

Experimental Methods

Site Selection

Three sites were selected for investigation. The first was a central urban site on the roof of County Hall, the second a suburban back garden in East Sheen, and the third another back garden close to the Surrey/London boundary at Sunbury-on-Thames. The location of these sites is shown in Fig. 4. The rationale behind the choice of sites was, firstly, to sample a range of environmental conditions, secondly, to carry out some experiments in actual garden situations and, thirdly, to be reasonably close to ozone monitoring equipment. During the time of these experiments ozone monitoring was carried out at Kew and County hall by the GLC.

Ozone Monitoring

Two different methods are used by the GLC to monitor ozone. The system operated at Kew was based upon a UV absorption technique. In this method ambient air is pumped through a narrow tube approximately 1m in length containing, at one end, a UV source, and at the other end, a UV detector. Since ozone absorbs UV light, the degree of attenuation in the tube determines the ozone content of the air. At County Hall a chemiluminescent technique was used. Here ambient air is mixed with ethylene in a reaction chamber. The ensuing chemical reaction between ethylene and any ozone present leads to emission of visible radiation which is detected photometrically. Both systems have a response time of about 20s. The ozone concentration data were recorded continuously on magnetic tape and analysed by PDP8 computer.

Indicator Plants

The majority of plants exposed were of the Bel-W3 variety. A few Bel-B cultivars were also used. All of these plants were provided by the Department of Botany of Imperial College. Usually each batch of plants in the field was replaced after four weeks by a fresh batch. In some cases there was an overlap of 'old' and 'new' plants so that their relative sensitivities to ozone could be assessed. At the Sunbury site just one batch was left for the entire period to give information on the effect of ageing of plants to ozone sensitivity. The plants at County Hall roof site were grown in pots surrounded by a mesh screen to protect them from high winds. At the other sites they were grown in the open garden.

Identifying and Recording Ozone-Induced Damage

The characteristic white to pale brown necroses appearing on the leaves of Bel-W3 after exposure to ozone are comparatively easily identified. These are well-illustrated in the pictorial atlas of air pollution injury to vegetation (Hill *et al.* 1970).

The amount of injury was recorded at approximately 1 or 2 week intervals. This was done by visually estimating the percentage of surface area covered by ozone-induced necroses for each leaf on each plant.

Period of Study

Plants were exposed from late May until early August, 1979. Experience has shown that this is usually the part of the year during which London experiences the highest ozone concentrations.

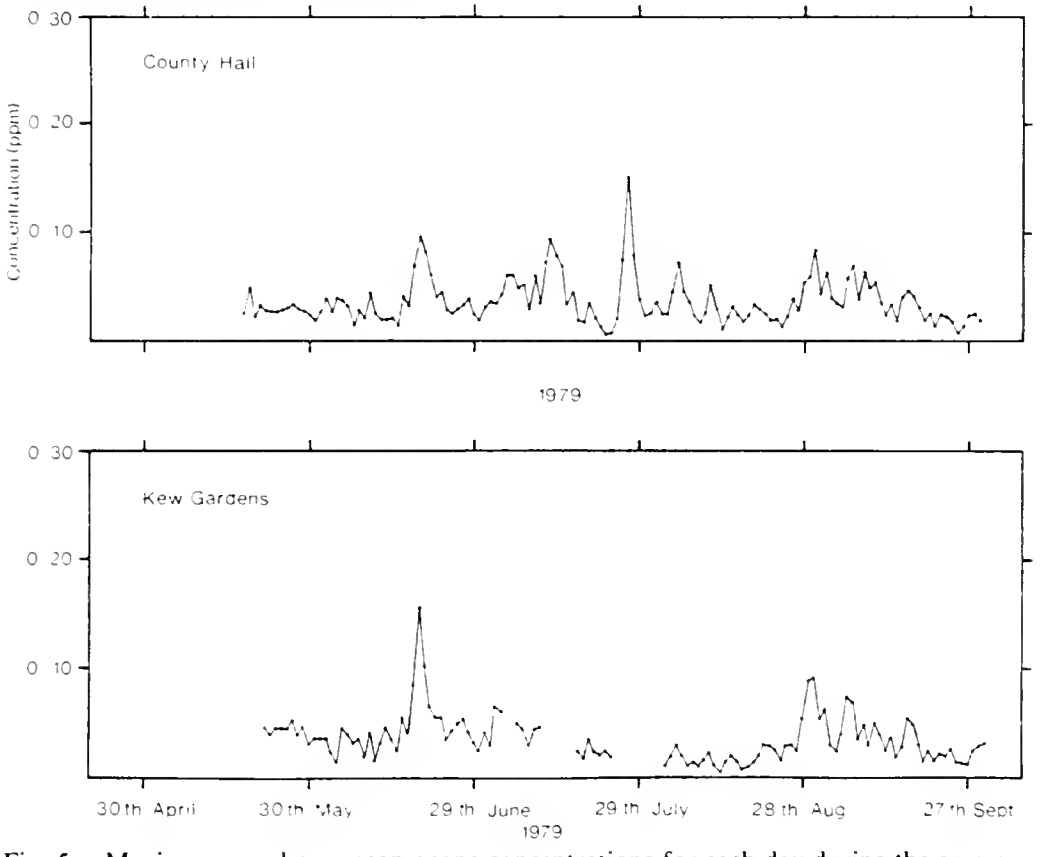

Fig. 5. Maximum one hour mean ozone concentrations for each day during the summer of 1979.

Results and Analysis

Ozone Concentrations during the Summer of 1979

Maximum daily ozone concentrations (1h mean values) for County Hall and Kew Gardens are shown in Fig. 5 for the summer of 1979. Some data are missing due to malfunction of the apparatus. During most of the summer ozone concentrations were comparatively low and close to the natural background concentration of .04 ppm expected at this latitude. However, one or two 'incidents' of photochemical activity stand out when concentrations of 0.15 ppm were reached (19 June at Kew and 27 July at County Hall). In fact, these concentrations are moderately high as far as London is concerned, the highest recorded value being 0.21 ppm in the unusual summer of 1976 (Ball and Bernard 1978).

Fig. 6. Leaf of *Nicotiana tabacum* (Bel-W3) showing flecking, mainly on the lower half of the leaf, of the type attributable to damage by ozone. The photograph was taken at East Sheen during June 1979.

A Preliminary Examination of Lesions on Bel-B and Bel-W3 Varieties

From 16 May until 16 June six plants each of Bel-B and Bel-W3 were grown side-by-side at East Sheen. Five of the Bel-W3 plants developed lesions, resembling those reported elsewhere as due to photochemical pollution, during this period. Fig. 6 shows typical damage on one of these plants. In contrast no lesions of this type were observed on any of the Bel-B plants. At Sunbury two plants of each variety were grown side-by-side. One of the Bel-W3 variety showed damage symptoms. Less damage was recorded at this site than at the other two.

The Correlation of Damage to Bel-W3 with Elevated Ozone Concentrations

'Mean ozone damage indices' were calculated according to the method of Bell and Cox (1975) for each plant for each period of observation (usually between 7 and 14 days). This index for each leaf is simply equal to the difference between

TABLE 2. Plant damage and ozone exposure data for the County Hall site.

Batch No.	Period of exposure: from	Period of exposure: to	Plant variety	Number of plants	Ozone damage index	Ozone data from C.H. for designated period: No. of hours >.04 ppm	Ozone data from C.H. for designated period: Highest 1h concentration (ppm)
1	5 May	22 May	W3	5	9.2	*	*
1	23 May	3 June	W3	5	0	0	.038
1	4 June	17 June	W3	5	0	13	.044
2	18 June	19 June	W3	5	0.3	14	.098
2	20 June	26 June	W3	5	3.0	20	.081
2	27 June	2 July	W3	5	0	0	.038
3	10 July	17 July	W3	5	4.0	64	.095
3	18 July	24 July	W3	5	2.8	0	.035
3	25 July	30 July	W3	5	0.2	42	.153
3	31 July	6 Aug	W3	5	0.1	20	.072

* missing data

TABLE 3. Plant damage and ozone exposure data for the East Sheen site.

Batch No.	Period of exposure: from	Period of exposure: to	Plant variety	Number of plants	Ozone damage index	Ozone data from Kew for designated period: No. of hours >.04 ppm	Ozone data from Kew for designated period: Highest 1h concentration (ppm)
1	5 May	15 May	B	6	0	*	*
			W3	6	0		
1	16 May	21 May	B	6	0	*	*
			W3	6	0.5		
1	22 May	3 June	B	6	0	33	.052
			W3	6	3.0		
1	4 June	16 June	B	6	0	13	.054
			W3	6	0		
2	12 June	19 June	W3	12	4.7	30	.156
2	20 June	30 June	W3	12	0.0	64	.101
2	1 July	15 July	W3	12	0.0	22	*
2	16 July	30 July	W3	12	0.0	0	*
2	31 July	6 Aug	W3	12	0.5	*	*

* missing data

TABLE 4. Plant damage and ozone exposure data for the Sunbury site.

Batch No.	Period of exposure: from	Period of exposure: to	Plant variety	Number of plants	Ozone damage index	Ozone data from Kew for designated period: No. of hours >.04 ppm	Ozone data from Kew for designated period: Highest 1h concentration (ppm)
1	16 May	23 May	B	2	0	*	*
			W3	2	0.9		
1	24 May	9 June	B	2	0	30	.052
			W3	2	0.7		
1	10 June	25 June	B	2	0	82	.156
			W3	2	1.4		
1	26 June	26 July	B	2	0	*	*
			W3	2	0.6		

* missing data

the percentage area of the leaf covered by ozone-induced necroses at the beginning and end of the specified period. The index for a plant is the average value for all leaves on the plant. As a crude measure of ozone-exposure, the total number of hours during which the concentration exceeded .04 ppm was calculated. There is some justification for the use of this index as far as Bel-W3 is concerned, as experiments have suggested that there is a threshold of .04 – .05 ppm for this variety below which no damage occurs. All of these data are recorded in tables 2, 3 and 4.

Looking first at the data for the County Hall site, Table 2, values of the ozone damage index vary from zero to 9.2 for the different periods. However, although the type of damage (e.g. Fig. 6) is exactly that expected from ozone, it does not appear to correlate well with either the number of hours above .04 ppm, or the highest ozone concentration. In particular, the ozone 'incident' of 27 July, reaching 0.15 ppm, had little, if any, apparent effect on the plants.

Similarly, the occurrence of damage at East Sheen, Table 3, shows surprising anomalies. For example, during the period 20 to 30 June, with 64h in excess of .04 ppm at nearby Kew the ozone damage index was zero.

Whereas Bell and Cox (1975) reported a significant positive correlation between these parameters for Bel-W3 plants grown at Ascot during 1972, *none* is apparent from these data ($r = 0.47$ for County Hall data alone, and 0.25 for all three sites together. Neither value is statistically significant, $p \gg 0.10$, and the data do not contradict the hypothesis of independence of ozone damage index and the ozone exposure parameter used here).

Discussion

The failure to find a statistically significant correlation between the mean ozone damage index and the ozone exposure parameter used here could possibly be discounted on the basis of the limited data set, or on the basis of several of the confounding factors discussed earlier (page 34). However, the fact that minimal or zero plant response was observed after several of the *main* photochemical 'incidents' of the summer is a disturbing pointer to the method's fallibility, regardless of explanations. In addition the physiological factors discussed so far do not seem, by themselves, to be adequate to account for such gross anomalies.

A further possible explanation for the failure to find the expected correlation, and for the apparent gross anomalies in plant response, is that Bel-W3 loses its ozone-sensitivity after its first exposure to photochemical pollution. Thus, with reference to Table 2, the first batch of plants was damaged in the first period of exposure (5 – 22 May), but not later. More important, batch 3 suffered considerable damage during its first week (10 – 17 July), but very little from 25 – 30 July although the ozone concentration reached its highest value of the summer at this site during the latter period. Similarly, the results from batch 2 at East Sheen (Table 3) are consistent with this hypothesis. Most damage occurred upon first exposure (12 – 19 June), and none at any later date, although many hours with ozone concentrations in excess of .04 ppm were recorded. Thus the most serious deviations from the anticipated pattern can be explained. This may also be the reason why the single batch of plants exposed at Sunbury showed, on average, less damage than those at the other sites. Usually suburban or rural areas are found to experience higher ozone concentrations than city centres as photochemical pollution takes several hours to form in the atmosphere and drifts some way downwind of the urban source area during this time, except during exceptionally calm weather (Ball and Bernard 1978). Consequently more damage would usually be expected at an outer site such as Sunbury, than in the city centre. If this is the correct explanation it implies that in using *Nicotiana tabacum*

Bel-W3 as an indicator plant attention should be given to renewing the stock at frequent intervals and particularly after damage has been recorded, if a continuous record is required.

Partly for this reason it was considered worthwhile to investigate the use of an alternative ozone-sensitive plant such as *Ipomaea* since this plant has the possible advantage of producing many new leaves throughout the growing season, which may lengthen the effective life of the plant as an indicator. It is also readily available from seed merchants in the UK, which *Nicotiana tabacum* Bel-W3 is not. Nouchi and Aoki (1979) report on work in Tokyo with the *Ipomaea* variety Scarlet O'Hara. The first tests in London were with this variety and variety Heavenly Blue, and took place in the summer of 1980 at St Margaret's. At the time of writing some necroses of a type reported as similar to those caused by ozone have been observed at the beginning of June. Confirmation cannot yet be offered as the inclement weather since has so far eliminated the possibility of further occurrences of photochemical pollution in London.

Conclusions

1. The use of plants as indicators of photochemical pollution has been examined in London during the summer of 1979 and 1980. The 1979 study used varieties of *Nicotiana tabacum,* one of which developed characteristic ozone-induced necrotic lesions during exposure to the ambient atmosphere at a number of locations in Greater London. Observations on *Ipomaea* in 1980 are at a preliminary stage, and the results as yet inconclusive.

2. Against expectations, the mean damage recorded on *Nicotiana* during time intervals of a week or two did not correlate with the duration of elevated ozone concentrations. While a number of physiological and environmental factors might be invoked by way of explanation, some of the anomalies are sufficiently gross as to test their plausibility. It is suggested that a more likely explanation may be a loss of ozone-sensitivity by the plants after their first exposure to photochemical pollution.

3. Nonetheless, it is clear that some plant varieties which may be grown in a number of situations in the London area, are susceptible to local concentrations of photochemical pollution, although there is still some progress to be made if the desire is to relate plant damage to the actual ozone dose.

Acknowledgments

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Talitroides dorrieni (Hunt) (Crustacea; Amphipoda) in the Royal Botanic Gardens, Kew, Surrey

by R. COLIN WELCH*

On 17 November 1980 I was kindly given permission by Mr J. Keesing, superintendent of the Royal Botanic Gardens, Kew, to examine the oak collection which has been planted close to the River Thames south of Brentford Ferry Gate. Whilst searching amongst the leaf litter beneath a large willow oak *Quercus phellos,* a native of the Atlantic States of North America, I noticed a small crustacean which, at first sight, resembled a *Gammarus.* This appeared to be sufficiently unusual for collection of the specimen for closer examination.

I was aware that Gledhill *et al.* (1976) had recorded *Orchestia cavimana* Heller from the 'shore of the Thames at Isleworth Ferry, Richmond' with the habitat given as 'under stones etc., just above the water's edge'. As this locality is almost adjacent to the site of my find, I thought my specimen might belong to this or another species in the semiterrestrial genus *Orchestia.* The earlier work by Reid (1947) provided not only a key to *Orchestia* species but also the other genera of the family Talitridae. It quickly became apparent that the specimen was a species of *Talitroides,* most probably *T. dorrieni,* a species described by Hunt (1925) from material from the Isles of Scilly. Reference to Lincoln's newly published monograph on British Marine Amphipoda (1979) confirmed the identity of the specimen. Lincoln mentions *T. allaudi* (Chevreux), an alien species known from the Royal Botanic Gardens, Glasgow, and a greenhouse in Norwich, but he regards *T. dorrieni* as the only truly British species.

Talitroides dorrieni is characterised by the following:-

Antenna 1 reaching beyond peduncle article 4 of Antenna 2
Outer rami of urogomph 2 subequal
Telson with few long dorsolateral spines
Pleopod 3 vestigial
Basal segment of Pereopod 7 broad with posterior margin serrate.

Lincoln summarises the distribution of *Talitroides dorrieni* as Cornwall, Dorset, Surrey, Isles of Scilly, Co. Galway and recently reported from beech leaf-litter in Argyll. According to Rawlinson (1937) and Murphy (1973) it is usually found in damp humus, dead leaves and other decaying vegetation. Dr Lincoln kindly confirmed my determination and commented that, 'there can be little doubt that this is an introduced species, from where we do not know (it is unrecorded outside the British Isles), that it is now well established in south west England and is most likely spreading north and east'.

Anyone who has course to examine leaf litter in the London area should keep a watchful eye open for this unusual and distinctive coloniser.

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British Prosobranch Molluscs; their functional Anatomy and Ecology. By V. Fretter & A. Graham (1962).
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British Tortricoid Moths Vols 1 & 2. By J. D. Bradley, W. G. Tremewen & Arthur Smith (1973, 1979).
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On the Diptera Associated with Dog-Dung in London

by Y. Z. ERZINÇLIOĞLU*

The dung of various domestic animals has long been regarded as a good source of Diptera by entomologists, and many systematic studies have been carried out on the subject. However, surprisingly few studies have been conducted on the dipterous fauna of dog-dung, in spite of its prevalence in many urban areas of Britain. Furthermore, although the role of dung-frequenting flies in the mechanical transmission of disease has been appreciated for quite a long time, investigations on this subject have been carried out mainly in tropical and subtropical countries where the problem is much greater than it is in temperate lands. In 1963 Wilton published a study of the dipterous fauna of dog-dung in a residential area in Hawaii and provided quantitative data on the productivity of this medium. More recently Disney (1972) carried out a short study of the Diptera associated with dog-dung in the City of Bath and drew attention to the lack of information on the subject. He also discussed briefly the possible role of Diptera associated with dog-dung in the dissemination of enteric diseases such as Salmonellosis. This problem, although a relatively minor one in Britain, is by no means non-existent and detailed studies are needed to elucidate the extent of the role played by flies in the transmission of these diseases. Smith (1973) published a short summary of the state of knowledge of the subject and suggested a closer look at owners' habits of allowing their dogs to defecate in public places.

During the summer of 1978 I carried out a similar study to Disney's in the Highbury area of north London. A routine was established whereby samples of dog-dung were collected once a week from a variety of localities around the Arsenal Football Club. These selected localities included pavements, gardens, areas immediately outside food shops, the area outside the entrance to the Arsenal Underground Station and the entrance to the football club itself. The dung samples were then placed in jars containing peat for rearing. A total of seventy-four samples were collected. Immediately before collection of samples a sweep net was used to collect any adult flies visiting the dung. The study was begun on 13 May and terminated at the end of August 1978.

The commonest flies seen visiting the dung were the calliphorids *Calliphora vicina* (the common bluebottle) and *Lucilia sericata* (a greenbottle). The former species was very common during May and June but was not very much in evidence later, when *L. sericata* was the commonest species together with flesh-flies of the genus *Sarcophaga* (Sarcophagidae). It was not possible to identify all specimens of this genus to species, but all those that could be identified proved to be *S. carnaria*. Other visiting species included *Musca domestica* (Muscidae) and *Fannia canicularis* (Fanniidae), the housefly and the lesser housefly respectively. In shaded and secluded spots in gardens species of *Leptocera* (Sphaeroceridae) were often present in large numbers. Although specimens of the yellow dungfly *Scathophaga stercoraria* (Scathophagidae) were frequently seen in gardens, they were never seen actually on the dung. In May flies of the genus *Muscina* (Muscidae) were occasionally seen feeding on the dung.

The flies reared from the dung were mostly *Musca domestica,* but a few specimens of another muscid, *Polietes lardaria,* also emerged. D'Assis Fonseca (1968) stated that this latter species breeds in cow-dung; however, I believe it has

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been reared from dog-dung before. In many samples sarcophagid larvae were present but, although some pupated, none emerged. An interesting feature of these results is that none of the species reared by Disney emerged from my samples. By far the commonest fly reared by Disney was the anthomyiid *Paregle radicum;* the muscid *Mydaea ancilla* and *Fannia monilis* also emerged from his samples. The difference in species composition between the present study and Disney's can probably be explained by the fact that London is, of course, a much more highly urbanised locality than the City of Bath and, therefore, one would expect most of the dung species there to be flies well known to be associated with man. The cosmopolitan *Musca domestica* was the commonest species to emerge from Wilton's samples which were collected in the densely populated city of Honolulu in Hawaii. Both Wilton and Disney observed that fewer flies emerged from dry than from moist dung. They also noted that the majority of species seen visiting the dung were not reared from it. Both these generalisations hold true in the present study.

The frequent presence on dog-dung of three common species of flies, *Calliphora vicina, Musca domestica* and *Fannia canicularis,* observed during the course of this limited study is probably of some medical importance. All three species commonly come indoors and settle on food whenever the opportunity arises. While collecting specimens in the busy shopping areas of Highbury, I frequently noticed these species entering shops and settling on items of food. Even sun-loving flies such as *Lucilia* and *Sarcophaga,* which do not often come indoors, were commonly observed to settle on meat and fish placed near the entrances of shops or just outside them. The probability of these flies disseminating enteric infections in this way is therefore very great, and it is possible that the role of dung-breeding species is not as important as that of those species which simply visit the dung for feeding. Smith calculated that dog-dung in Britain could produce up to 130 billion (130^{12}) flies per annum; the number of flies that visit the dung is probably much greater. Clearly more detailed systematic and quantitative studies of this important subject are needed, especially in densely populated urban areas.

The nomenclature is according to KLOET, G. S. & HINCKS, W. D. 1976. A Check List of British Insects. Ed. 2. Part 5: Diptera and Siphonaptera. *Handbk Ident. Br. Insects* **11** (5).

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The use of an Ultrasonic Receiver to obtain Distribution Data for Pipistrelles and other Bats within the London Area

by J. H. D. HOOPER*

Abstract

The history and use of portable ultrasonic receivers ('Bat Detectors') for listening to the orientation signals emitted by bats (Chiroptera) are described. These instruments can be tuned to the frequency at which an optimum response is obtained for any particular species, the result being presented to the observer as an audible sound from a loudspeaker. For some bats, the information thus provided is sufficiently characteristic to enable the species to be identified. This technique has been used for the recognition of bats, and especially pipistrelles *Pipistrellus pipistrellus*, in western and certain central areas of London. During the period 1965 – 1980, sites over which bats might be expected to hunt, as for example stretches of water such as rivers, reservoirs, lakes and gravel pits, have been checked using an ultrasonic receiver. Data are presented for 222 sites of this nature, within the London Area, at which ultrasonic signals from flying bats were detected, and in most cases, identified. Specific bat records have been obtained for several of the Inner London parks, including St James's Park, Kensington Gardens, Hyde Park, Regent's Park and Buckingham Palace Gardens.

The nomenclature follows Corbet, G. B. 1969, *The identification of British mammals*, ed. 2. British Museum (Natural History), London.

Introduction

Mammals such as bats, whose haunts are rarely obvious and which hunt at dusk or in darkness, present obvious difficulties to the worker who wishes to study them. Where particular species are known to inhabit accessible haunts, as for example greater or lesser horseshoe bats *Rhinolophus ferrumequinum* and *R. hipposideros* in caves, then of course opportunities arise for local studies of such individual species. However to obtain information about bats on a more general basis and to establish the variety and numbers inhabiting a particular area is far less easy. Thus knowledge of the distribution of bats in urban areas such as London has long remained scanty and has mainly had to rely on occasional findings, largely by chance, of individuals in their summer haunts, where they could be identified and counted. In the 'New Naturalist' book on the natural history of London, published in 1945 (Fitter 1945: 113), the only reference to bats totalled just eight lines, and mentioned that 'bats' (unidentified) had been seen in St Paul's cathedral and also probably roosted in old trees in the parks. In 1968, available information on bats in the London area was published in this journal in a comprehensive report by Beames (1968). This listed the species recorded, mostly as a result of identification in the hand of bats found in house roofs or quarry tunnels, caught by mist netting, or of dead specimens (some of which had been shot). More recently, additional information on bats in London has been published by Burton (1974) and in a booklet on wildlife in the Royal Parks (Simms 1974). Both these authors referred to places where hunting bats have been seen, as for example over the lakes in the London parks, but for most of the sites listed the bats were not identified and only in a few cases was it possible to recognise the actual species seen. This of course is hardly surprising. Reliable visual identification of a small creature, dimly glimpsed in the dusk, and possibly a long distance from the observer, must always be questionable, to say the least.

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Fortunately however, within recent years, the naturalist has been presented with an instrument which can be of great help in the identification of flying bats, and without the need for reliance on actual sightings of such bats. This is a tunable ultrasonic receiver, popularly known as the 'bat detector'. The purpose of the present paper is to describe the use of such an instrument in the London Area, and specifically in the outer suburbs to the west and south-west and in central London parks, during the period 1965 – 1980.

Ultrasonic signals emitted by bats and the development of receivers to detect them

It is well known that bats emit high frequency sounds and rely, for flight guidance and feeding, on the echoes they hear when such sounds are relected back from obstacles or insects. These sounds are generally well above the range of the human ear. To put them in perspective, the top treble note on a piano is about 3500 Hz* (3.5 kHz) and the highest note detectable by the average adult is about 17 kHz. Although bats frequently utter squeaks which are quite audible to human ears, as when angry, the sounds they use for orientation are rarely so and are typically in the range between 20 and 100 kHz, and for some species, even higher. These ultrasonic noises, conveniently referred to as 'ultrasounds', are essentially in the form of short pulses (in effect, squeaks), emitted many times a second, and differ from one species to another in terms of frequency range, pulse repetition rate, pulse duration, and presence of harmonics. The idea of a portable receiver which could be used in the field for detecting such ultrasounds was developed in the USA, round about 1958, by McCue and Bertolini (1964) on behalf of Dr D. R. Griffin, the great pioneer of research into bat ultrasonics. This instrument, which was never produced commercially, was sensitive to signals over the full frequency spectrum of sounds emitted by bats, and each short duration pulse detected produced a click from a loudspeaker. This certainly indicated that a bat was within range of the microphone, but gave little or no guidance as to what kind it was. Dr Griffin demonstrated this receiver to various bat workers during a visit to Britain in 1960 and from this demonstration sprang a series of discussions under the enthusiastic leadership of Andrew Watson, Secretary of an informal 'Bat Group' of the Mammal Society, with the object of promoting the commercial manufacture of a bat detector for general use by naturalists.

These discussions received valuable help from Dr J. D. Pye, then at the Institute of Laryngology and Otology, who had developed, for his own bat researches, a detector which could be used more selectively than Griffin's broad band instrument. In simple terms, it was basically a modified version of a superheterodyne type of transistor radio, with the output from the microphone replacing the signals normally received from the aerial. It had a relatively narrow pass band (about $\pm$ 5 kHz) and thus had to be tuned, like a radio set, to pick up different species of bat, according to the frequencies being emitted. (Pye and Flinn 1964). A special feature was the inclusion of a Beat Frequency Oscillator circuit (BFO) which enabled the instrument to give a characteristic response when a signal of constant frequency was detected. The use of this facility is described later. By 1963, general agreement had been reached on a specification for a 'tunable' bat detector with similar capabilities, and a precision electronics firm near Southampton, Holgate's of Totton Ltd, then undertook to try and develop a production instrument. This, following the testing of several prototypes, was achieved by the autumn of 1964, and the resultant 'Holgate Ultrasonic Receiver' was, until 1977, the only tunable bat detector that was available commercially. It is in fact the receiver which has been used for the majority of the observations tabulated in this paper.

* Hz is the abbreviation for the S.I. unit used in the measurement of sound frequencies, the Hertz. (1 Hz = 1 cycle per second). For convenience, it is usual to express 1000 Hz as 1kHz.

Briefly, the Holgate Ultrasonic Receiver consists of a metal box 24 x 16.5 x 13 cm containing the main circuitry, the beat frequency oscillator, a loudspeaker and the necessary batteries. With its microphone, and a waterproof carrying case, it weighs 3.9 kg. A control panel at the top incorporates a tuning dial graduated over the range 10 – 180 kHz, a volume control, a switch for the BFO facility and sockets to allow the ultrasonic or audio signals to be fed to other equipment. The most important item, the special microphone needed to pick up the high frequencies involved, is a solid dielectric capacitance transducer (Kuhl *et al.* 1954) of the same basic type as used in Griffin's instrument and also by Pye. It incorporates a pre-amplifier circuit in its handle and requires about 180 volts to polarise one plate of the capacitor.

When the Holgate receiver was first marketed, little was known about the ultrasounds emitted by British bats and so users of the instrument had to discover, by lengthy trial, the frequencies appropriate to each species, and the nature of the responses to be expected. However, after much practice, it became apparent that such responses could be used for the identification of at least some species of bat. This has been described, for example, by Watson (1965) and Hooper (1969). For such usage, the detector had to be tuned to various known frequencies according to the bats expected, and an inevitable consequence of this was that other bats, emitting different frequencies, could then fly by undetected. In other words there was a need for a dual purpose detector combining a broad facility to listen over the full spectrum of possible bat emissions and a tunable system to enable a bat, once detected, to have its optimum frequencies pinpointed. This need was fulfilled in 1977 when the Research Group at Queen Mary College under Professor J. D. Pye worked out a compact design for a combined broad band/tunable detector (Pye 1980a). This, under the designation S.100, has been placed on the market by QMC Instruments Ltd, but unfortunately its price places it well beyond the reach of the amateur naturalist. Perhaps in compensation for this, the same firm, in 1978, went into production with a relatively cheap and literally pocket-sized bat detector. This, the QMC 'Mini' detector, fitted into a case originally intended for a transistor radio (130 x 70 x 40 mm) and even with batteries, only weighed 270 grams. A surprising feature is the fact that the built-in microphone is an ordinary electret transducer designed for use at audio frequencies. Its response at ultrasonic frequencies could thus be expected to decline rapidly, but this is offset by compensating circuitry in the amplifier. (Pye 1980b). The sensitivity of this 'Mini' detector is in fact just as good as that of the Holgate receiver. It is tunable over the range 10 – 160 kHz, and incorporates a BFO circuit.

Use of an ultrasonic receiver for the identification of bats

The means whereby a bat detector can be used to recognise individual species of bat has been described elsewhere (Hooper 1969), but a brief outline of the broad principles may be helpful.

For bats native to the British Isles, the ultrasounds emitted may be divided into three basic groups:-

(1) A frequency sweep, dropping from a high frequency (say 80 kHz) to a level about an octave lower (30 – 40 kHz) in a very short time, usually of the order of 5 milliseconds or less. This type of sweep, repeated many times in each second, is characteristic of *Myotis* species such as Daubenton's *M. daubentoni,* Natterer's *M. nattereri,* whiskered bats *M. mystacinus,* etc. If the bat detector is tuned to a setting within the frequency range of the sweep, the loudspeaker will emit a rapid series of clicks.

(2) A pulse of long duration, lasting sometimes for as much as 50 milliseconds, and essentially at a constant frequency. To obtain an audible response from the

bat detector for this type of pulse, use has to be made of the Beat Frequency Oscillator. This generates a synthetic signal of constant frequency and if this signal is combined with the one being received from the bat, the result is what is known as a 'beat note', with a frequency equal to the difference between the two signals. If, by adjustment of the tuning dial, this difference is made fairly small, say between 500 and 1000 Hz, then the beat note is brought within the audible range, and is heard as such as a 'bleep' from the loudspeaker. Such long, constant frequency pulses are emitted by the rhinolophid (horseshoe) bats, and the responses obtained when the detector is tuned to the right frequency for a greater horseshoe bat (80 – 85 kHz) or a lesser horseshoe bat (105 – 110 kHz) are unmistakeable.

(3) A pulse which combines both the above features, in other words one which starts as a rapid drop in frequency and ends with a short period at a constant frequency. In this case, according to the tuning setting selected, either a click or a 'bleep' response may be obtained from the bat detector. The setting needed for the bleep response can provide a useful clue to recognition of the bat involved. This kind of pulse is emitted by pipistrelles, *Nyctalus* species (noctules *N. noctula* and Leisler's bats *N. leisleri*) and serotines *Eptesicus serotinus*.

When bleep responses are obtained, the sound quality of the bleep coupled with knowledge of the tuning setting, usually enable a firm identification to be made without much difficulty. The problem arises for those bats for which only clicks are heard from the loudspeaker. Even so, differences may be noted in respect of repetition rate and the nature of the click (e.g. whether it is a light 'tick' or a heavy 'tock'). In this connection, the Holgate receiver has a definite advantage since it's speaker cone is large enough to impart some measure of character to the clicks it produces, whereas with the tiny speaker of the QMC Mini detector, all the clicks sound very much the same.

In summary therefore, although it cannot be claimed that the ultrasonic receiver will permit identification of all the British species, nevertheless, under favourable conditions, it can provide sufficient information to enable some bats to be recognised without ambiguity and others to be grouped under various broad headings, as listed below:-

(1) Pipistrelle
(2) *Nyctalus* species (noctule or Leisler's bat)
(3) Daubenton's bat
(4) Natterer's bat (probably)
(5) Other *Myotis* species
(6) Serotine
(7) Greater horseshoe bat
(8) Lesser horseshoe bat

Of the remaining British species, the long-eared bats *Plecotus auritus* and *P. austriacus* and the barbastelle *Barbastella barbastellus*, can perhaps be listed as being recognisable by default in that their ultrasonic emissions are so weak that they will not be detected at ranges much greater than 2 metres from the microphone.

Reference is made above to the need for 'favourable conditions' in using an ultrasonic receiver for bat identification. This implies firstly, that for a given species, the bat detector is already tuned to the right frequency; secondly, that the bat continues to fly within microphone range for long enough for the necessary checks (possibly at more than one frequency) to be made; and thirdly, that confusion is not caused by the simultaneous presence of other bats, either of the same or of a different species. Perhaps one typical problem may be quoted. For certain recognition of a pipistrelle, a single pass of the bat, detected at 45 kHz is

often sufficient. At this frequency setting however, the second harmonic of a close flying noctule would also be heard as well as any Daubenton's bats that might be in the vicinity. To separate these two last named species from the pipistrelle, it is necessary to 'tune out' the pipistrelle by cheeking at frequencies below its lower limit (*ca* 40 kHz). Thus, at 35 kHz, the pipistrelle, if still present, would not be heard, but for Daubenton's bats there would be a strong response. This would fade out on tuning down below 30 kHz, at which setting the detector would begin to pick up the fundamental frequencies of any noctule pulses. Further decrease in the tuning setting to about 22 kHz would cause the instrument to emit rather bell-like chirrups if the noctule was still within range. To do all this in the darkness, taking careful note of the relationship between tuning setting and responses heard, and for bats that keep coming and going, is rarely easy.

The use of ultrasonic receivers to detect bats in the London area

a) Outer London

In 1964 I began trials with an ultrasonic receiver as a means of listening to bats, using an early prototype (Mark II), which Holgate's had made by converting a commercially available transistor radio. In 1966, with the aid of a 50% grant from the Nature Conservancy, I was able to purchase a production version of the Holgate receiver. This was a special 'one-off' Mark VI model which differed from the standard (Mark V) receiver in that it incorporated an experimental pulse rate meter on its control panel. My early experiments, for a long time merely to gain experience with these instruments and to make tape recordings of their responses to bats, were carried out in the vicinity of my home at Staines, and particularly by the lake at Virginia Water, where pipistrelles, Daubenton's bats and noctules were common. Later, as confidence was gained in the use of the Holgate receiver to identify bats, I extended my searches, still within the Staines area, to establish as many sites as possible where bats could be 'detected' and hopefully recognised. It was soon apparent that the most profitable places to check were the many stretches of water in the area as these, because of the local concentrations of flying insects over the water, were obviously popular with the bats as feeding zones. A brief report on bat detector observations in the neighbourhood of Staines was published in 1970 (Hooper 1970) and this was followed in 1977 by a more extensive account, for a much wider area (Hooper 1977). A number of the sites listed in these two publications lie within the area of prime interest to the London Natural History Society, namely a circle of 20-miles radius, centred on St Paul's Cathedral, but are included in the tables below, so as to provide a comprehensive listing of bat detector observations in the area over the period 1965 – 1980.

The bulk of the observations listed were made using the Mark VI Holgate receiver, but were usefully augmented in 1978, when the QMC Mini detector became available. This enabled me to overcome the obvious disadvantage with a tunable detector, namely that one can only listen on one frequency at a time. Thus when using the Holgate receiver, by itself, to listen for *Nyctalus* species at 22 kHz, the instrument would not respond to pipistrelles or other species for which a setting of 45 kHz was required. Attempts to resolve this difficulty by repeatedly changing from one setting to the other were troublesome, especially in the dark and when trying to maintain control of a tuning knob, a torch, a microphone and possibly a tape recorder. With the acquisition of the QMC Mini detector — light enough to hold in the same hand as the Holgate microphone — it became a simple matter to listen at two frequencies simultaneously, and my normal practice was to tune the QMC instrument to 22 kHz (for *Nyctalus* species, which it could pick up at very long ranges), while having the Holgate receiver set to 45 – 50 kHz in readiness for pipistrelles or *Myotis* species.

As already mentioned, a useful rule in searching for hunting sites used by bats is to look for a stretch of water, and to follow this rule presents no problem in SW London, which offers the River Thames, numerous smaller rivers, canals, gravel pits, reservoirs, and ponds or lakes in parks or on commons. For convenience therefore, these various types of water site have been used as a basis for the tables that follow, and which list, for the period 1965 – 1980, the sites where flying bats have been detected, and in most cases identified, using an ultrasonic receiver. In these tables, an average grid reference is given for each site together with letters or other abbreviations to indicate the species of bat, the year of observation and whether or not the bats were numerous. Attention is drawn to the 'key' summarising these various abbreviations, which are common to all the tables.

The sites, where bat detector observations have been made in the outer London Area, with positive results, are listed as follows:-

TABLE 1 River Thames
TABLE 2 Other rivers (and canals)
TABLE 3 Parks and lakes
TABLE 4 Reservoirs, gravel pits and other large areas of water
TABLE 5 Ponds, commons, other open spaces and 'miscellaneous'

Table 5 lists a number of sites such as streets and gardens not necessarily near a stretch of water, and also includes the very few sites where bats have been detected leaving their actual haunts.

b) Inner London

Until the end of 1971, effort was largely concentrated on hunting sites located in 'Green Belt' areas and the outer suburbs where relatively large expanses of open space were still to be found. In 1972 it was felt of interest to see whether bats could also be found hunting in more densely built-up areas, and specifically in 'Inner London'. At that time, available published information on this subject was not very encouraging. The record of London bats published in 1968 by Beames (1968: 43) listed only four findings of bats in Inner London since 1925, the most recent being a dead pipistrelle found in Holland Park in 1962. It was thus gratifying, on taking my bat detector to St James's Park, in June 1972, to pick up no less than five pipistrelles flying over the lake at dusk. This encouraged the checking of further London parks and I quickly established that the Holgate receiver could pick up pipistrelles hunting over the Serpentine in Hyde Park and over the lake in Regent's Park. In the latter park, I unfortunately overlooked the fact that the gates are closed before the bats become really active, and at the conclusion of my first visit, I found myself locked in. For future visits, this difficulty was overcome when the Royal Parks Division of the Department of the Environment kindly gave me permission to enter the Royal Parks after 'closing time' (with prior notification to the various Superintendents concerned), and so during the period 1972 – 1974 I was able to confirm that bats regularly hunted over stretches of water in several of London's parks and commons. Details of such hunting sites lying within the area categorised by the London Natural History Society as 'Inner London' are given in Table 6. Other similar areas, although not quite so centrally located, where bats were heard and identified, included Clapham Common, Wandsworth Common, Mitcham Common, Tooting Bec Common and Hampstead Heath, and these have been listed in Table 5.

It is also perhaps of interest to list a number of additional sites in central London which were checked, but at which no bats were heard when I visited them. These included Green Park (1972), the Thames embankment near the Royal Festival Hall and the Victoria Embankment Gardens opposite (1973), the Grand Union Canal at 'Little Venice' (1974) and the ornamental lakes forming

part of the Barbican Scheme (1974). A check for high-flying bats from the roof of Broadcasting House in September 1972 was unsuccessful and so also was a long wait for bats alleged to fly out from a tower at Guy's Hospital (1974).

Discussion

The sites listed in the tables are those where flying bats were actually 'detected': for reasons of space, many other places also checked but at which no bat detector responses were obtained, have been omitted. Such negative observations, and also the positive ones set out in the tables, were of course in many cases merely the result of a single visit to each of the areas concerned. Such 'snap' sampling does not necessarily give a true picture. Experience has shown that if bats are not heard at a particular place on a particular night it does not necessarily mean that they will not be heard there if a return visit is made at a later date. The converse also holds true. Some sites, which have apparently been popular hunting zones for several summers in succession, may well be found, the next season, to support no bats at all. The reasons for such inconsistencies are difficult to establish. Possibly, in some cases, a summer haunt has been lost as a result of the destruction of a building or a change in its use. In other cases, it is the hunting zone itself which has been changed. There have been many examples of this in the neighbourhood of Staines. Several gravel pits, formerly good sites for listening to bats, have been filled in and are now fields again: other stretches of water have disappeared as a result of major roadway projects, and in particular the construction of the M3 and M25 motorways. For this reason a number of water sites where bats were heard in the early 1970s and which would otherwise have been listed in the tables, have been omitted.

The work described is part of a continuing project. Ideally, all the sites listed should be checked each year, and so also should many other likely areas where bats have not yet been found. This ideal is, unfortunately, far beyond the ability of a single worker and limitations of time have also prevented any extension of the work to cover other regions of the London Area. The present paper lists 222 sites at which bats have been heard, in little more than one quadrant of the area: it is reasonable to hope that the northern, eastern and southern quadrants could each yield just as many similar records of bats.

The fact that so many hunting zones have been recorded for bats in such a limited area naturally poses the question, 'Where do all these bats live?'. During the course of this work, despite appeals for information from local natural history societies, very few summer haunts have come to light. The few that have are indicated in Table 5. It can only be assumed that many householders, even of quite modern property, are unknowingly providing shelter for colonies of bats. As a case in point, it was discovered during the summer of 1980 that a three-storey 'town house' in Sunbury was supporting a colony of at least 90 pipistrelles. These emerged from behind a fascia board at roof level, and as the roof was flat it seems likely that their living space was a gap between this board and the concrete beam behind. Another pipistrelle haunt, and a rather unusual one, which I visited in 1977, was at the back of a house in East Sheen. Here, a roller blind could be pulled out to give shade to a terrace, and the bats occupied the long iron box into which the blind rolled back when not in use.

The data presented in the tables underline, to some extent, the limitations of the technique used. In the first place, it has not yet been found possible, solely on the basis of bat detector observations, to differentiate between noctules and Leisler's bats. For this reason, although it is believed that the majority of such bats detected were in fact noctules, the element of doubt remains and so it has only been possible to record the recognition of *Nyctalus* species. Secondly, for a number of sites, bats were detected which could not be identified, usually because

they did not remain within microphone range long enough for appropriate checks to be made. Some of these have been included in the tables, with the designation 'unknown'. On the other side of the coin however, it should be noted that the data tabulated, even if sometimes limited, could not have been obtained by any other method and that the majority of the identifications listed (*ca* 70%) are for bats that were never actually seen and which would have flown by unnoticed if the ultrasonic receiver had not been switched on.

The main fact which stands out clearly from even a casual inspection of the tables is the widespread distribution of the pipistrelle. This bat was noted, often in large numbers, at 192 out of the 222 sites listed. Commenting on the status of pipistrelles in the London Area, John Burton (1974: 148) wrote as follows:-'Regarded as commonest bat but the few accurate identifications make it impossible to assess its distribution. Probably occurs well into suburban and even urban areas'. The distribution data needed to confirm Burton's assumptions would appear to be amply provided by the present paper.

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KEY TO THE ABBREVIATIONS USED IN THE TABLES

P = Pipistrelle
N = *Nyctalus* species (Noctule or Leisler's bat)
D = Daubenton's bat
S = Serotine
U = Unidentified

Year figures omit the '19'; e.g. '79' = 1979

The approximate number of bats detected is indicated by the letter suffix after the year number, as follows:-

a = 1 bat, single pass
b = 1 bat, several passes
c = several passes, believed more than 1 bat
d = at least 3 bats
e = numerous bats
H = bats leaving their haunt, e.g. flying from a roof

TABLE 1. Bats recorded, using ultrasonic receiver, by the River Thames.

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
HYTHE END (WRAYSBURY) TO STAINES			
Hythe End	012 723	P	71c
Bell Weir Lock	017 720	P	68a
Egham, E. of A30 bridge	022 718	P	71a
Egham, towpath by gas works	026 717	P	71b
Staines, Lammas recreation ground	029 718	P	71b
Staines bridge	032 716	P	71c
STAINES TO CHERTSEY			
Staines, railway bridge	036 712	P	70e, 71e
Staines, St Peter's Church	037 706	P	70d, 77c
Staines, Wheatsheaf Lane	036 700	P	70e
Staines, Penton Avenue	040 698	P	70e
Laleham, Thames Water Authority intake	048 694	P	70d
Laleham, Vicarage Lane	050 687	P	71c
Laleham, by Laleham Abbey	051 683	P	71d
		N	71b
Laleham, recreation area	051 677	P	65e, 66e, 67e, 68e, 71e
		N	65e, 66c, 68e
Chertsey weir	054 670	P	71e, 72e
		N	68b
CHERTSEY TO WALTON			
Chertsey Bridge	055 665	P	71c
Dockett Eddy	066 663	P	71c
Dockett Point	066 659	P	71c
Pharaoh's Island	070 660	P	71c
Shepperton Lock	073 659	P	71a
Weybridge, Ferry Eyot	078 660	P	71c
Weybridge, Desborough Channel	081 660	P	71c
Shepperton, by church	079 667	P	71a
Lower Halliford, Walton Lane	085 668	P	71a

TABLE 1. [CONTINUED] Bats recorded, using ultrasonic receiver, by the River Thames.

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
WALTON TO KINGSTON			
Walton Bridge	093 665	P	71c
		N	71b
Walton, near ferry	097 667	P	71c
Walton, by oil depot	102 675	P	80c
Sunbury, by church	107 685	P	71e
Sunbury Lock	108 684	S	80c
Sunbury, by Darby Crescent	115 689	P	71a
Hampton, Platts Ait	132 692	P	71e
Hampton, Taggs Island	147 692	N	71a
		U	71b
Hampton Court Park, towpath	173 677	P	71c
Hampton Court Park, towpath	177 686	P	71b
Kingston Bridge	176 693	P	71a, 73a
KINGSTON TO KEW			
Teddington Lock	165 717	P	77a
Ham, towpath (Ham Lands)	164 721	P	77c
Ham, Young Mariners' Base	163 724	P	77d
Twickenham, Orleans House	171 733	P	71b
Richmond Lock, footbridge	170 752	P	73c
Old Deer Park, towpath	169 756	P	73e
Kew Palace	186 775	P	74a
Kew Green	188 776	P	74a

TABLE 2. Bats recorded, using ultrasonic receiver, at river sites (other than Thames) and by canals (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
NORTH OF THE THAMES			
MISBOURNE			
A412 bridge, E. of road	037 871	P	77a
COLNE			
Denham, Green Bridge	045 883	P	75d
Uxbridge, by 'General Elliott'	049 837	P	75c
Cowley, Packet Boat Lane	047 810	P	71c, 77c
		N	71a
		S?	71a
West Drayton, Thorney Road	053 789	P	71d
Harmondsworth	052 779	P	71c
Longford, A4 bridge	050 772	P	73e
Staines Moor	031 727	P	71c
Staines Moor, Staines bypass	036 724	P	69e
COLNE BROOK			
Uxbridge, A4007 bridge	045 835	P	75d
Colnbrook bypass	031 774	P	71b
Horton	020 756	P	71b
Wraysbury, by station	015 743	P	71c
Hythe End, bridge	018 727	P	71c, 74c
		N	71a
Hythe End, Ferry Lane	018 724	P	71a

TABLE 2. [CONTINUED] Bats recorded, using ultrasonic receiver, at river sites (other than Thames) and by canals (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
WYRARDISBURY RIVER			
South of M4	051 783	P	71c
		N	71c
Harmondsworth	050 780	P	71c
Longfordmoor, Mad Bridge	041 766	P	71c
Poyle, tributary to Colne Brook	031 764	P	71e 74e
Staines bypass, S. side	033 724	P	71c
DUKE OF NORTHUMBERLAND'S RIVER			
Harmondsworth	054 777	P	71c
		N	71a
ASH			
Littleton, Squires Bridge	070 684	P	71c
Charlton, Charlton Road	081 684	P	71d
Shepperton, Watersplash Farm	096 674	P	71a
CRANE			
Hanworth Crematorium	121 735	N	80c
GRAND UNION CANAL			
Uxbridge	050 830	P	75c
		N	75a
Harefield Moor	050 884	P	75a
GRAND UNION CANAL (SLOUGH BRANCH)			
Crossing over River Colne	048 807	P	77b
Langley, W. of Market Lane	018 800	P	77b
Langley, by Industrial Estate	014 800	N	77b
SOUTH OF THE THAMES			
ABBEY RIVER			
Chertsey, Ferry Lane	043 672	P	71b
THE BOURNE			
Addlestone, Crockford Bridge	053 641	D	71c
Chertsey, Free Prae Road	044 664	P	71a
WEY			
Byfleet, Plough Bridge	070 613	P	71d
		D	71c
Brooklands, motor racing circuit	068 631	P	72d
		D	72d
Weybridge, Addlestone Road	068 648	D	71d
MOLE			
Cobham, Cobham Bridge	099 605	P	74d
Cobham, Cricket Ground	101 603	P	74a
Hersham, Old Esher Road	121 645	P	71a

TABLE 2. [CONTINUED] Bats recorded, using ultrasonic receiver, at river sites (other than Thames) and by canals (Outer London).

Site	*Grid Ref.* TQ/–	*Species*	*Year*
Esher, S. of Esher Bridge	128 643	P	71a
		U	71b
East Molesey, Ray Road	136 676	P	73d
East Molesey, Green Lane	139 676	P	73c
East Molesey	145 676	P	73b
EMBER			
East Molesey	146 673	P	73b
HOGSMILL RIVER			
Ewell, Kingston Road	219 630	P	72c
Kingston, Springfield Road	183 687	P	74e
Kingston, Brook Street	180 690	P	74d
WEY NAVIGATION			
Byfleet, Dartnell Park	055 613	P	71c
		D	71b
Basingstoke Canal Junction	055 621	P	71c
New Haw Lock	055 631	P	71c
		D	74c
Coxes Lock	061 641	P	71d
		N	71c
By Ham Moor	063 644	P	71c
		D	71c
Addlestone Road, footbridge	065 647	N	71a
		D	71c

TABLE 3. Bats recorded, using ultrasonic receiver, at sites in parks and by lakes (Outer London)

Site	*Grid Ref.* TQ/–	*Species*	*Year*
THORPE WATER PARK			
Public footpath between lakes (mean)	033 682	P	79c
		N	79e
LITTLE BRITAIN LAKE, COWLEY			
South side of lake	049 811	P	71d, 77c
CLAREMONT PARK, ESHER			
Lake (mean)	129 631	P	80e
		N	80d
		D	80e
		S	80a
BUSHY PARK			
Diana Fountain	158 692	P	71d
Heron Pond	163 695	P	71e
Leg of Mutton Pond	167 698	P	71e
		N	71b

TABLE 3. [CONTINUED] Bats recorded, using ultrasonic receiver, at sites in parks and by lakes (Outer London)

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
HAMPTON COURT PARK			
Long Water (mean)	164 683	P	73b
		N	73c
Rick Pond	171 680	P	73c
Main Avenue	171 686	P	73a
		N	73b
Hampton Wick Pond	173 692	N	73c
OSTERLEY PARK			
East end of lake	150 786	P	72d
		N	72c
SYON PARK			
Main Drive	171 767	P	75a
KEW GARDENS			
Lake (mean)	180 767	P	74e
		N	74e
Lily Pond	181 765	P	74b
Pond by Palm House	188 770	P	74e
RICHMOND PARK			
Pen Ponds, S. pond	198 729	N	78b
		D	78d
Pen Ponds, N. pond	199 730	P	78d

TABLE 4. Bats recorded, using ultrasonic receiver, at reservoirs, gravel pits and other large areas of water (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
RESERVOIRS			
Staines Reservoirs, causeway (mean)	052 731	P	65e, 66e, 68e, 69e, 70b, 74d, 75d, 77e, 78d
		N	65e, 66e, 67d, 68e, 69e, 70d, 74e, 75a, 77e, 78e, 79e
King George VI Reservoir, N. side	046 743	P	71c
		N	71c
		U	71b
Queen Mary Reservoir, New Road	079 688	P	71c
		N	71c
Queen Mary Reservoir, Spelthorne Road	083 698	N	80e
Queen Mary Reservoir, yacht club area	078 705	P	80c
		N	80e
Reservoirs, Hanworth, central footpath	116 709	P	77c
		N	77c
Hampton, Filter beds	130 691	P	71e
Ruislip Lido	087 893	P	77b
Brent Reservoir, near Cool Oak Lane	218 876	P	78a
		N	78d

TABLE 4. [CONTINUED] Bats recorded, using ultrasonic receiver, at reservoirs, gravel pits and other large areas of water (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
Brent Reservoir, N. side (mean)	214 872	P	78b
		N	78d
Brent Reservoir, near cemetery	212 871	N	78c
GRAVEL PITS, ETC.			
O.S. SHEET TQ 06			
Thorpe Green, gravel pit, S. side	014 683	P	80c
		N	80c
Thorpe, gravel pit	023 681	P	71d
Thorpe, gravel pit, S. of Green Lane	029 697	P	79e
Penton Hook, marina	041 687	P	71b
Chertsey, gravel pit, S. of M3	057 673	P	72e
Littleton Lane, gravel pit	061 676	P	71c
		N	71c
Littleton Lane, gravel pit, path by M3	062 672	P	77d
		N	77b
Shepperton Green, footpath between gravel pits	066 673	P	77e
Pool End, gravel pit, by bridge over M3	069 672	P	77b
Pool End, gravel pit, W. of Sheep Walk	070 675	N	77b
Halliford, lake W. of Halliford Road	090 687	N	77c
Shepperton, lake E. of Walton Bridge Road	092 668	P	73b
O.S. SHEET TQ 07			
Wraysbury, gravel pit, E. of High Street	006 741	P	79e
		N	79c
Horton, footbridge between gravel pits	008 747	N	79c
Horton, gravel pits (mean)	011 752	N	79c
Hythe End, gravel pit	017 730	P	74e
		N	74c
Hythe End, pit N. of Wraysbury Road	021 725	P	71c
Staines, gravel pit, W. of Moor Lane	024 729	P	71c
		N	71d
Egham Hythe, Greenham's Pit foot bridge	027 703	N	79c
Stanwellmoor, pit to E. of Moor Lane	033 746	N	70e
Old Slade Nature Reserve, lake	037 781	P	67e, 68d, 71d, 74d, 75d
		N	67e, 68d, 71e, 74c
Old Slade, Costain's lake, south end	037 778	P	71c
		N	71d
Old Slade, Costain's lake, north end	040 779	P	71d, 74e, 75e, 76e
		N	71c, 74c
Stanwellmoor, Greenham's Pit	039 753	P	71b
Stanwellmoor, pit W. of A3044	046 748	P	75c
		N	75c
Stanwellmoor, pit E. of A3044	048 749	N	75c
Longford, pit near Moor Round-about	047 769	N	75d

TABLE 4. [CONTINUED] Bats recorded, using ultrasonic receiver, at reservoirs, gravel pits and other large areas of water (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
O.S. SHEET TQ 08			
Pit E. of Iver (Ford Lane)	044 812	P	71c
Yiewsley, gravel pit, N. side	054 805	N	77c
O.S. SHEET TQ 16			
East Molesey, gravel pit, E. Common Lane	130 670	P	73a
		N	73b

TABLE 5. Bats recorded, using ultrasonic receiver, at miscellaneous sites including ponds, commons, streets and gardens (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
O.S. SHEET TQ 06			
Thorpe, Crabtree Corner	020 695	P	71b
Chertsey, Colonel's Lane	042 671	P	71c
Chertsey, Burway Ditch (stream)	046 678	P	71b
Laleham, Home Farm, pond	055 693	P	71a
Weybridge, pond N. of Brooklands	066 629	P	72d
Byfleet, Silver Mere	081 610	P	74b
Weybridge, Broadwater (mean)	089 657	P	80e
		N	80d
		D	80c
O.S. SHEET TQ 07			
Runnymede, Langham's Pond	004 722	P	74c
		U	74a
Wraysbury, Ankerwyke Farm	007 731	P	71b, 74d
		N	74c
Wraysbury, lane S. of B376	010 729	P	67c, 71b
Wraysbury, Tithe Farm	011 742	P	71c
Staines, pond E. of Moor Lane	026 728	P	70b, 71b
Staines Moor, by Yeoveney Halt	028 734	P	71c
Staines, Richmond Road, pond	038 713	P	64c, 66c, 67b, 73b
Staines, Commercial Road, stream	045 707	P	71c
Ashford, Shortwood Pond	047 718	P	71b
		N	68c
Ashford, Shortwood Common, pond	053 717	P	71b
Ashford Manor Golf Course (mean)	070 708	P	79b
		N	79d
Feltham Hill, B.P. office site, pond	092 712	P	71c
		N	71c
O.S. SHEET TQ 08			
Ruislip Pond	091 878	U	77a
O.S. SHEET TQ 16			
Sunbury, Green Street	105 685	P	80H
Hersham, Albany Road	115 646	S	65H
Esher, West End Pond	127 638	P	67e, 68e, 71e
		D	71e
Esher Common, Black Pond	128 623	P	71e
Esher, Wolsey Road	136 646	S	67H, 68H

TABLE 5. [CONTINUED] Bats recorded, using ultrasonic receiver, at miscellaneous sites, including ponds, commons, streets and gardens (Outer London).

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
Weston Green, pond by Alma Road	149 663	P	75b
Epsom Common, Stew Pond	186 609	P	78d
		N	78d
O.S. SHEET TQ 17			
Kempton Park, lake by railway	117 705	N	77c
O.S. SHEET TQ 18			
Ealing, pond by W. Middx Golf Course	142 806	P	75c
Ealing, Brent Golf Course	143 807	P	75a
Perivale Wood, Nature Reserve	160 836	P	73b
O.S. SHEET TQ 24			
Reigate, Earlswood Common, pond	267 485	N	70e
O.S. SHEET TQ 26			
Ewell, Timbercroft	211 647	P	72a
Mitcham Common, pond	286 683	P	75b
		N	75a
O.S. SHEET TQ 27			
East Sheen, Stonehill Road	207 747	P	77H
Barnes Common, pond at NW. corner	219 763	P	74c
Barnes Common, footpath N. of Mill Road	222 761	P	74e
Barnes Common, by Ranalegh Avenue	225 762	P	74a
Barnes Common, by Putney Cemetery	229 761	P	74a
Putney Heath, King's Mere	231 732	P	73d
Wandsworth Common	274 737	P	73e
Clapham Common, Mount Pond	287 747	P	73d
		N	73b
Tooting Bec Common, N. end of pond	291 722	P	74d
		N	74b
O.S. SHEET TQ 28			
Hampstead Heath, Hampstead Ponds (mean)	272 859	P	73d
		D	73c
Hampstead Heath, Highgate Ponds (mean)	278 865	P	73c

TABLE 6. Bats recorded, using ultrasonic receiver, in Inner London.

Site	*Grid Ref.* TQ/ –	*Species*	*Year*
BATTERSEA PARK			
N. end of Boating Lake	283 773	P	74b
BUCKINGHAM PALACE GARDENS			
'Island' in lake	288 795	P	74b
		N	74a
ST JAMES'S PARK			
W. section of lake, N. side	294 798	P	72c, 73a, 74b
E. section of lake, S. side	296 797	P	72c
E. section of lake, by café	297 799	P	74d
KENSINGTON GARDENS			
By Kensington Palace	260 801	U	74a
Round Pond, S. and W. sides	261 800	P	74d
Round Pond, N. and E. sides	263 802	P	74e
Near Speke's Monument	266 803	U	74a
Long Water, near Peter Pan statue	267 805	P	73b, 74d
Long Water, by bridge	268 803	P	74d
By fountains	268 806	P	74c
		N	74a
Near Magazine Gate	269 804	N	74b
HYDE PARK			
Serpentine, N. side	271 802	P	73d
Serpentine, N. side, W. end of island	274 801	P	73e
		N	72b, 74b
Serpentine, N. side, near Dell Restaurant	277 802	P	72b, 73e, 74e
		N	72d
Serpentine, S. side	276 799	P	72c
REGENTS PARK			
Boating Lake, NW. lobe	277 826	N	72c
Boating Lake, W. side	278 825	P	72a
Outer Circle, by Sussex Place	278 823	N	72b
Outer Circle, by Zool. Soc. offices	278 834	P	72a
Inner Circle, near The Holme	280 826	P	72b
Grand Union Canal, Macclesfield Bridge	274 833	P	72e

Survey of Bookham Common:

THIRTY-NINTH YEAR

Progress Report for 1980

General (G. Beven*)

Partly as the result of a generally organised recruiting day at the end of June, and partly due to increased interest, the active membership of the survey has considerably enlarged. Projects in ornithology and botany have been continued and extended, while others have been taken up again as in mycology and entomology.

The laying of the main sewer is now complete and is largely tidied up. It is hoped to survey the vegetation which develops along the track.

Vegetation (Bryan Radcliffe †)

After the intensive recording effort of 1977 – 79 this has been a quiet year with few exceptional finds. One of interest was our third individual of *Rhamnus catharticus* discovered by the Keeper, Ian Swinney, while clearing scrub encroaching on Central Plain.

R. catharticus can be either polygamous or dioecious. Two of our plants carried abundant fruit, the other, none at all. The three are comparatively remote from each other (not less than 400m) so cross pollination to any significant extent is unlikely. It seemed probable therefore that the individuals in divisions Q and S were polygamous while that in T appeared to be of the dioecious form. The trees in Q and T were visited in 1980 in the flowering season, and the first was found with hermaphrodite flowers (styles and pollen present) while the second had only male flowers.

Carex demissa and *Pedicularis sylvatica,* not recorded recently, were found in 1980. New sites were noted for *Dryopteris pseudomas* and *Polystichum setiferum.*

A species of more than usual interest was first noted in November. This was *Rosa stylosa,* represented by one bush only on a pathside in division P. Available information suggests that *R. stylosa* is comparatively rare in Surrey.

Subject to expert confirmation, a water starwort noticed by Veronica Pilcher in Bayfield Pond is *Callitriche brutia;* known in earlier Floras as *C. intermedia* ssp. *pedunculata.* This has been elevated to specific rank in *Flora Europaea.*

The acorn 'knopper gall' *Andricus quercuscalicis* was first noted on the Common in October 1977, and it is hoped to record its distribution there in 1981, the best months for finding the galled acorns on the trees may be August – September. This is important for ecological work as a heavy infestation could seriously reduce the amount of winter food available for some mammals and birds. In November 1980 a search revealed that the crop of normal acorns

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over a great part of the Common had been very poor. No population explosion of the gall had been noted which might have accounted for the failure of the crop. There is another possible cause in the severe frost on the night of 9 – 10 May 1980 when a record low minimum temperature for the month of May (– 3.1°C) was registered at Kew.

Fungi (E. M. Hillman*)

The following fungi, collected by Pamela Goldsmith and myself, and identified or confirmed by Peter Holland, have not previously been recorded on the Common:

Boletus subtomentosus	12 Oct. 1980	E.M.H.
Calocera cornea	July 1980	P.G.
Russula mairei	12 Oct. 1980	E.M.H.

In addition, several species not recorded since 1947 – 9 were found, 26 by P.G., 5 by E.M.H. (but 29 in all). Peter Holland has in recent years found 14 new species and re-found 73 from older records, and has compiled an annotated Check-list of the Fungi and Myxomycetes of the Common, copies of which are in the Society's library and in the Research Hut library. It is hoped that his valuable contribution will proceed to future publication.

Bryophytes (R. C. Stern†)

Recording has continued during the year, with Mr O. B. J. French in particular finding new localities for several species. Work is also continuing on the preparation of a bryophyte flora, and Mr French has started an investigation into the epiphytes of different trees.

There has been no new moss or liverwort record for the Commons during the year, but the following species have been rediscovered for the first time since before 1967. The habitats are as given in Miss Hillman's paper in *Lond. Nat.* **54** : 49 – 58 (1975) and nomenclature follows the *Census Catalogue of British Mosses* by E. F. Warburg (1963) and the *Census Catalogue of British Hepatics* by J. M. Paton (1965).

	Area	*Habitat*	*Remarks*
Phascum cuspidatum	0	2a	—
Cratoneuron filicinum	0	1d	Bare ground in new marsh.
Marchantia polymorpha	E	2a	On burnt ground.
Radula complanata	0	7a	—

Lichens (J. R. Laundon††)

The woodlands of Bookham Commons were visited on 9 November 1980 in order to see if there had been any significant changes in the lichen vegetation since the last survey of 1969 – 73 (*Lond. Nat.* **52** : 82 – 92 (1973)). An examination of the epiphytes indicated that the lichen flora was much the same as in the early 1970s, there having been no significant improvement, but fortunately no decline either. This contrasts markedly with the situation found by the 1969 – 73 study, which, when compared with the first survey of 1953 – 56, revealed a considerable depletion in the epiphytic lichen flora. This decline was attributed to increased sulphur dioxide air pollution resulting from substantial residential building development at Great Bookham and Fetcham, immediately to the south of the

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commons. As lichen epiphytes are known to be accurate guides to air quality, the present stable situation indicates that air pollution levels at Bookham Commons have remained fairly constant over the past decade. To the north-west of London at Ruislip a recent significant increase in the lichen flora has been attributed to falling air pollution levels (*J. Ruislip Distr. nat. Hist. Soc.* **22** : 23 – 29 (1979)); apparently there is no evidence of a corresponding improvement to the south-west of London.

In the Bookham Commons woodlands *Hypogymnia physodes* extends up the trunks of a number of immature oak *Quercus robur* trees, whilst *Parmelia sulcata* covers the upper surfaces of a small number of old oak branches. However, both species are associated with few other macrolichens, and no *Evernia* was found. It is gratifying to record that the single plant of *Parmelia caperata,* noted in 1973 from an old oak bordering the Broadway in area J, is still present; its diameter has increased from 3 cm in 1973 to 5 cm in 1980. This is still the only known specimen on the commons of this pollution-sensitive lichen.

Annelida Oligochaeta (J. Coles*)

Earthworms: *Lumbricus rubellus*
Collected from area N square 58 (near Western Hollows Pond) on 6 August 1980 and October 1980.

Crustacea (J. Coles)

Cladocera. From the Isle of Wight Pond, 28 June 1980.

Ilyocryptus sordidus	*Bosmina longirostris*
Scapholeberis mucronata	*Daphnia cucullata*

Copepoda

Cyclops sp. immature.

The plankton fauna of the Isle of Wight Pond seems quite good but the bottom fauna is still rather sparse and I have not seen any worms from that pond since it was cleaned out in 1972 – 3. All crustaceans identified by Dr G. A. Boxshall.

Birds (G. Beven)

Population Studies in Oakwood

In January G.B. developed a right sided hemiplegia following a heart operation and was unable to do any serious work on the bird count. The woodland counts were not frequent enough especially in April and May, so that the total number of birds was considerably lower than in 1979. Thus the 1980 results are not considered comparable.

Population Studies in Scrub and Grassland

The breeding season census was repeated in 39 hectares of scrub and grassland in 1980 (W. D. Melluish). the number of territories for 1977, 1978, 1979 and 1980 respectively was, for wrens 22, 26, 18 and 10; and for robins 34, 30, 40 and 33. Thus the wrens had decreased further although the robins were still numerous. Blackbirds however reached their highest figure (1977, 22; 1978, 22; 1979, 21; 1980, 27). Grasshopper warblers were not recorded for the fourth successive year.

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Other Notes on the Birds

Little grebes had two young on Lower Eastern Pond. A pair of Canada geese nested on Isle of Wight Pond and produced one young. This is believed to be the first breeding record for the common. A male shoveler was on the Isle of Wight Pond on 3 April (Ian Swinney). A common snipe was on a pool on Western Plain on 15 October (D. A. Boyd), and a party of 4 common sandpipers was present at the same place on 14 December (W. D. Melluish). On 14 September a yellow wagtail was seen (A. Merritt). The last two records apear to be new for the Common.

Mammals (G. Beven)

On 7 February 155 grey squirrels were culled (Ian Swinney). A dormouse was found on 12 November on Bayfield Plain (763). It was asleep in a tight grass nest on the ground two feet from a hawthorn bush about 15 feet high. It was moved in its nest, to a similar site at the base of another hawthorn nearby, as the previous one had been cut down during scrub clearance. The dormouse squeaked a little and then went to sleep again (see *Lond. Nat.* **57** (1978) for two previous records since 1964) (Ian Swinney).

Vascular Plants of Bookham Common: A New Survey

by BRYAN RADCLIFFE* AND KEN PAGE†

Summary

A. W. Jones' paper, entitled 'The Flora of Bookham Common' (*Lond. Nat.* **33** : 25 – 47 (1954)) appeared approximately a quarter of a century ago. This provided an invaluable background to the ecological work of other disciplines. In recent years however the need for an up-dated background has become apparent. The following account is based on a re-survey of the Common in the period 1977 – 79 with the object of defining present day distribution and assessing the nature and extent of changes since 1953.

Introduction

The main body of data for the earlier Flora was collected over a period of a single year although it was supplemented by many earlier records of less common plants. The principal effort was put in by a team of five botanists, with some assistance from three others and from the remaining Bookham Survey members.

The Bookham team has shrunk since 1953 and we could not hope to match this effort at any time with numbers. It was therefore decided to extend the new survey over three years. Recording was mainly carried out by the authors, with welcome assistance from time to time from other members whose names appear at the end of this account.

For recording purposes the Common is arbitrarily split into twenty 'divisions' of roughly similar size, lettered A – T. The boundaries of these consist of clearly defined topographical features, principally main pathways, and have no ecological significance. The recording base was of course the same for the 1953 and 1977 – 79 surveys. The divisions are indicated on the base map.

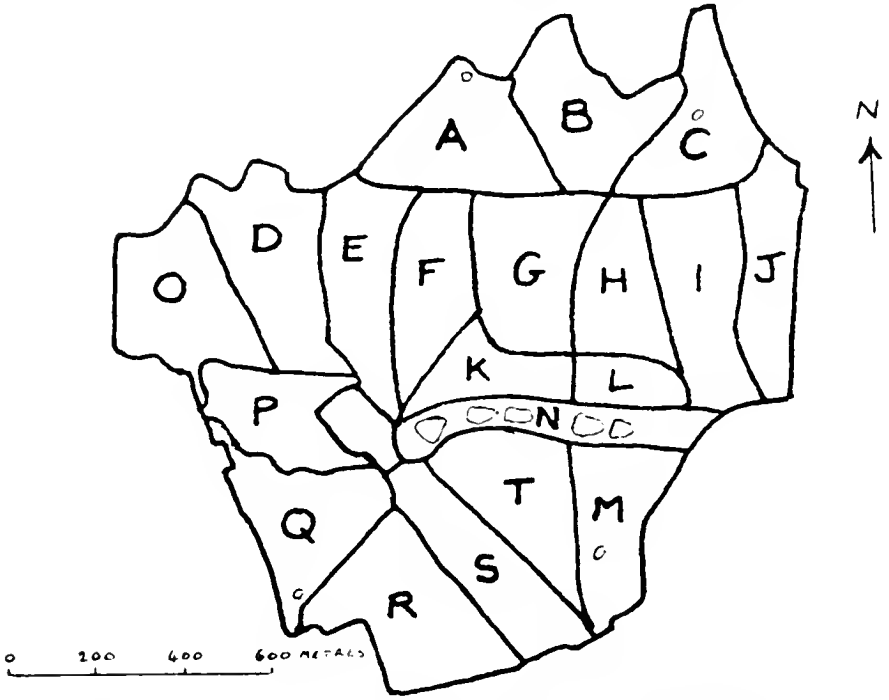

FIG. 1. Outline map of Bookham Common showing recording divisions.

* 82 Tattenham Grove, Epsom Downs, Surrey KT18 5QS.
†10 Cannonside, Fetcham, Leatherhead, Surrey KT22 9LE.

For the sake of brevity no authorities are cited for the plant names. In the systematic list names follow the usage of Clapham, A. R., Tutin, T. G., and Warburg, E.F. (1962) *Flora of the British Isles*. Ed. 2, although it is recognised that a number of names in this work are now out of date.

Since the main objective has been comparison of the flora in the two periods we have omitted from this account records in the 1954 Flora which were not fully identified or clearly located. However, it was considered desirable to include species of the 1954 Flora found only before that survey, because a number of these turned up again in the 1977 – 79 survey.

All the acceptable records of the 1954 Flora and the 1977 – 79 survey are compared in a systematic list that forms an appendix to this paper. The following tabulated data were derived from this:-

	1954 Flora	*1977 – 79 survey*
Total records of fully identified and located species	3141	2985
Total records attributable to 1953 survey (excluding earlier records)	3085	
Records repeated (in particular divisions)		2226
Records lost		915
Records gained		759
Number of species	468	451
Species lost—from 54 Flora		89
—from 53 survey		65
Species gained—from 54 Flora		72
—from 53 survey		90
Total records of lost species		145
Total records of new species		121
Records of repeated species lost		770
Records of repeated species gained		638
Species found in all 20 divisions	13	27 (2 losses; 16 gains)
Total species, both surveys	540	
Species common to both surveys	379	

The first impression gained from this data is a surprising parity of results. The total records of the later survey amounted to 95% of the 1954 Flora (96.7% of those actually recorded in 1953.) The number of species seen was similar, differing by less than 4%. Such figures, taken in isolation, might be assumed to indicate little change since 1953.

If the data are examined in more detail however, a very different picture emerges. When the obvious changes of completely lost or newly gained species are discounted, among the species common to both surveys 770 records have been lost and 638 gained. The only conclusion possible from this is that a very substantial migration has occurred about the Common.

Significant change of another type is evident when consideration is given to species content. Although the species totals in both surveys are similar there have been substantial losses and gains of particular species. Little more than two thirds of the species were common to both surveys.

Inevitably, a considerable number of species seen were casuals. When a subjective attempt is made to discount these a core of some fifty gains and fifty losses remains. It is significant that a majority of the losses are of light-demanding species and a majority of the gains are shade-tolerant.

Comparison of surveys at species level

As might by expected after a 25-year period, most species showed some change in distribution, although with a limited number there appears to have been no change at all. The following groupings are of interest:

Species occupying entirely different divisions in 1953 and 1977–79

There are 39 species in this category, all of somewhat restricted distribution; most of which have suffered a nett loss. It is not surprising that species like *Solanum nigrum, Senecio sylvaticus, S. squalidus* and *S. viscosus* appear in this group. Less understandable, *Anemone nemorosa,* lost from its three former divisions appears in two new ones, while *Adoxa moschatellina* moves from one division to the next.

Species occupying the same divisions in 1953 and 1977–79

In this category there are 28 species, of which 11 were and still are found in all 20 divisions. The remaining 17, with one notable exception, are either rare or of very restricted distribution.

The exception is *Oxalis acetosella,* present in the same 14 divisions in 1953 and 1977–79. Although woodland coverage has increased and woods have developed in new divisions there has been no change. The unoccupied woods appear to be suitable for the species and it is difficult to account for the lack of migration. An autecological study of *O. acetosella* from this aspect might produce results of considerable interest.

Of the restricted species, *Stachys palustris, Viola reichenbachiana* and *Ophioglossum vulgatum* have maintained exactly the same divisions. *Geranium pratense* and *G. pyrenaicum* are known to be in the same places and the same applies to *Asparagus officinalis.* Indeed, the lone Asparagus plant first reported in 1950 is likely to be at least thirty years old.

Two rarities, *Scutellaria galericulata* and *Dactylorhiza maculata* ssp. *ericetorum,* with a single division apiece are known to have moved within their divisions. *S. galericulata,* formerly only by Upper Eastern Pond is now only by Lower Eastern Pond. *D. ericetorum* is now at least one hundred metres north of its former station on Eastern Plain.

Reductions of native species

Species not completely lost, but exhibiting a marked decline, are numerous. The outstanding example is *Alisma plantago aquatica,* now absent from 12 of its former 15 divisions. The reduction in wet habitats appears to be negligible and the main reason for the loss is likely to be increased shade.

Pilosella vulgaris, Cynosurus cristatus, Carex flacca, Potentilla anserina and *Trifolium dubium* have also lost ground substantially. All of these require good illumination for success.

The reduction in a shade-tolerant species, *Fragaria vesca* is anomalous, but it is thought that the anomalous situation may have existed in the period of the 1953 survey. *F. vesca* is not common in woodland where the soil has an acid reaction, as at Bookham. It was the practice in earlier years to lay chalk to repair paths, and this may have been responsible for both introduction and maintenance of *F. vesca.* Following cessation of chalk-laying a gradual reversion to acid conditions has occurred making the area less suitable. Nothing is known about the distribution of *F. vesca* prior to the 1953 survey.

Total losses of native(?) species

Prominent among our losses are 11 grass species. This is understandable, owing to reduction in the area under grass. It is possible that some have been missed in the later survey, but at least 4 of the 11 were probably only casual in 1953, because they were species more typical of calcareous soil.

Virtually all the remaining plants lost were rarities in 1953, occurring in 1 – 3 divisions only and were light-demanding species. Among those slightly more widespread, in 4 – 5 divisions were *Euphrasia nemorosa, Papaver rhoeas, Sinapis arvensis* and *Thymus pulegioides,* all plants of open ground.

Gains of new species

The relative abundance of *Holcus mollis* and *Luzula multiflora* is surprising in view of their apparent absence in 1953, although *H. mollis* was then reported as being close outside the edge of the Common. *Carex strigosa* has been known to one of us (K.P.) for many years, and may have been overlooked in 1953. Its characters do not differ greatly from the common *C. sylvatica.* The same may be the case for *Luzula forsteri,* superficially similar to *L. pilosa,* but because of its locations near the margins of the Common *L. forsteri* could be a relatively recent immigrant.

In contrast to its general decline in southern England the gain of *Erica tetralix* is also surprising. A few years ago it was comparatively frequent over a limited area of division D. More recently due to growth of birch scrub it was almost lost but steps have been taken to open up the remaining site in an effort to preserve the species.

It seems probable that *Salix aurita,* another generally declining species, was overlooked in 1953. On the other hand *Rhamnus cathartica, Allium ursinum, Potamogeton pusillus, P. obtusifolius* and *Dactylorhiza praetermissa* are likely to be newcomers.

Increasing species

Among the 26 species showing a nett increase in frequency of five or more divisions it is significant that 50% are trees or shrubs. Prominent also are shade herbs including three ferns, *Arum maculatum, Moehringia trinervia, Carex sylvatica* and *Sanicula europaea.* Virtually all of the species either require or tolerate shade.

The substantial gain of *Agropyron repens* appears at first surprising, but reference to the data indicates that the new records are mainly in the open areas. The other grass, *Festuca gigantea,* is shade-tolerant, but here again the increase has mainly been in the open divisions.

Epilobium adenocaulon has increased by 13 divisions. This reflects the general increase of this species in recent years over southern England.

Ubiquitous species

In 1953 there were 13 species that occurred in all 20 divisions. In 1977 – 79 the number had increased to 27. It is possible that the magnitude of this increase may be slightly exaggerated, because in the later survey, if a species was particularly widespread, special effort was made to find it in the remaining divisions. It is not known whether, under similar circumstances, a parallel special effort was made in 1953.

All of the 16 species newly occupying 20 divisions are common woodland or shade-tolerant species. Some are at present uncommon in their new divisions but are likely to increase progressively.

Cirsium palustre has been lost from 5 of its former 20 divisions. This species will survive for a time in shade but eventually succumbs. *Ranunculus flammula,* formerly also in 20 divisions has lost ground to 16. This species is still to be seen along many of the broad damp tracks through the woodlands where some sunlight penetrates. Elsewhere, owing to tree growth or track-narrowing it has been eliminated.

In 1953, *Betula pubescens,* recorded in only three divisions was stated to be 'Rare, or not distinguished from *B. pendula'.* In 1977 – 79 it was found in all divisions. *B. pubescens,* except locally, is not as common as *B. pendula* and some searching was necessary in some areas to find it. Nevertheless, it could not now be regarded as rare at Bookham. Hybrids between the two species were occasionally encountered.

Migration of species

The 'movement' of species across the Common, although visually apparent by inspection of distribution maps is difficult to quantify. The changes in overall totals in individual divisions are of no value because, for instance, gains of woodland species in the more open divisions are obscured by losses of open-ground species. A similar obscuration occurs in the wooded areas. The only feasible approach, at least initially, is to consider each species in isolation.

One technique that can be applied is as follows:-

(1) Assume a species record to be from the centre of a division.
(2) Establish the co-ordinates of the centre in terms of easting and northing.
(3) Calculate the mean easting (E_1) and mean northing (N_1) for all the records of the species in 1953. The pair of means thus represents the co-ordinates of the centre of distribution of the species at that time.
(4) Calculate the corresponding co-ordinates for records of 1977 – 79 (E_2), (N_2).
(5) ($E_1 - E_2$), ($N_1 - N_2$) represent the components of displacement of the centre of distribution over the period.
(6) Angle of displacement $\propto = \tan^{-1} \dfrac{(E_1 - E_2)}{(N_1 - N_2)}$ degrees
(7) Magnitude of displacement $\sqrt{(E_1 - E_2)^2 + (N_1 - N_2)^2}$ metres
(8) Assuming E_1, N_1 are at origin of axes,
when $E_2 > E_1$
$N_2 > N_1$ direction of displacement is in NE quadrant. Bearing = $\propto°$

$E_2 > E_1$
$N_1 > N_2$ direction of displacement is in SE quadrant. Bearing = $(180 - \propto)°$

$E_1 > E_2$
$N_1 > N_2$ direction of displacement is in SW quadrant. Bearing = $(180 + \propto)°$

$E_1 > E_2$
$N_2 > N_1$ direction of displacement is in NW quadrant. Bearing = $(360 - \propto)°$

(9) From step (5) onwards it is possible to consider the effect of species in combination. The algebraic sums of positive and negative eastings (E_R) and northings (N_R) can be computed and represent the co-ordinates of the nett displacement of centres.

The calculation was applied to 51 of the most common species that had undergone changes in distribution between 1953 and 1977 – 79. The selection of these species was made on the following criteria:-

(a) That the species was not present in all divisions in *both* surveys.
(b) That considering *both* surveys the species had occurred in not less than 17.

E_R for these 51 species was found to be minus 915 metres and N_R was minus 1169 metres, giving a nett combined centre displacement of 1485 metres. It should be noted that, had the migration of these species been random, the combined centre displacement would have been expected to be at or near zero, and thus the result is significant. The resultant bearing was found to be 218°, indicating that this displacement had occurred in a direction 7° south of south west.

In this particular investigation, approximations were inherent in steps (1) and (2). Thus, absolute positions for centres of distribution could not be established accurately. However, the calculations are meaningful in defining *displacements* of theoretical centres, both in magnitude and direction. Furthermore, errors diminish as the numbers of records considered approaches maximum potential; i.e. presence in all divisions; and a substantial number of species are selected. The calculations involved 1709 records (more than a quarter of total records of both surveys) and represented 84% of maximum potential for the 51 species.

The results provide numerical confirmation of qualitative observations that woodland plants are advancing in a south-westerly direction while open-ground plants are similarly retreating. It is apparent that natural succession towards climax oak forest is in progress after being held in check for a long period by biotic factors. The main factor was undoubtedly stock-grazing, which was formerly widespread, but contracted towards the south and west and finally ceased in 1949, not long before the 1953 survey. The removal of a long-standing gypsy encampment from the northern woodlands and several myxomatosis epidemics among the rabbits were no doubt contributary factors.

Although approximate parity in total species numbers has been maintained up to this latest survey the species content has shown significant change in the last 25 years. Woodland species have increased, balancing losses of open-ground plants. It seems inevitable that if the succession is allowed to continue there must be a decline in the future. Most of the potential woodland species are already present in the woodlands so there can be few new species of this type to offset future losses. The probable outcome is a reduction in the diversity of the flora and consequently, of species-specific organisms dependent on the flora.

Of one thing we can be certain — changes in the flora of Bookham Common will continue. We hope that botanists who will be active in the year 2004 will resolve to repeat the survey then to assess another 25 years of change.

Acknowledgments

It is not possible to name all who contributed records or helped in other ways, but we are grateful for their efforts. Prominent among them were Betsy Allen, Geoffrey Beven, Nigel Davies, Ella Hillman, Veronica Pilcher, Joan Stoddart, Ian Swinney and Stanley Thorley.

Systematic List

G = Gained (recorded only in 1977 – 79 survey)
L = Lost (recorded only in 1954 Flora)
/ = Repeated (recorded in both 1954 Flora and 1977 - 79 survey)

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Equisetum fluviatile														/						
Equisetum palustre														/						
Equisetum arvense		L		/						L			L	/	/		/	/	/	/
Pteridium aquilinum	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Phyllitis scolopendrium	G																	G		
Athyrium filix-femina	G		G				G	G			/							G		
Dryopteris filix-mas	/	/	/	/	/	G	G	/	/	/	/	/	/	/	G	G	/	/	/	/
Dryopteris borreri	G												G							
Dryopteris carthusiana	G	/	/	/		G	/	G	G		G	G		G	G		G		G	
Dryopteris dilatata	/	/	/	/	/	/	/	/	G	G	/	/	G	G	G	G	G	G	G	/
Polystichum setiferum		L	G	L										G				G		
Ophioglossum vulgatum																/	/	/	/	
Pinus sylvestris															/				G	
Taxus baccata	G	/	/			G	L	/	G	/	L	/	/	G					/	L
Anemone nemorosa	L	L							G	L							G			
Clematis vitalba																		L		
Ranunculus acris	/			L	/	L			/	/			/	L	/	/	L	/	/	/
Ranunculus repens	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Ranunculus bulbosus			L	G							L		/					L	L	
Ranunculus flammula	/	L	/	L	/	/	/	L	/	/	/	/	/	/	/	/	/	L	/	/
Ranunculus sceleratus	L		/											G	/					
Ranunculus peltatus														/			L			
Ranunculus trichophyllus														G						
Ranunculus hederaceus														L						
Ranunculus ficaria	/	/		/	/	L			/	/	/	L	/	/	/	/	/	/	/	/
Aquilegia vulgaris				G						L				L					L	
Mahonia aquifolium																		G		
Nymphaea alba														L						
Ceratophyllum demersum													G							
Papaver rhoeas					L								L		L			L		
Papaver somniferum										L			L				L			
Chelidonium majus										G										
Fumaria officinalis										L										
Sinapis arvensis				L	L								L		L					
Raphanus raphanistrum					L															
Coronopus squamatus															/		L			
Coronopus didymus				L									L							
Capsella bursa pastoris				L	/					G			/		/		L	L		
Lunaria annua																	L		G	
Erophila verna																		L		
Cardamine pratensis	/	L		L	/	G					/		/	/			/	/	/	/
Cardamine flexuosa	G		G	/	G	G			L	L	/		G	G		G		G	G	/
Cardamine hirsuta			G							G			G	G			G	/	/	
Barbarea vulgaris				G										G		L	L	/		G
Rorippa nasturtium aquaticum														G						
Rorippa microphylla														/						
Rorippa islandica															L	L				
Rorippa amphibia														G						
Hesperis matronalis															G	/	G	G		
Erysimum cheiranthoides													I					I		
Cheiranthus cheiri																	I			

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Alliaria petiolata			G	/					G	/			/	G	L	/	/	/	/	/
Sisymbrium officinale				/									I		L		G	/		
Arabidopsis thaliana																G		/	L	
Viola odorata		G																/		
Viola riviniana	/	/	G	/	/	/	/				/	/	/	G	G	/	/	G	/	/
Viola reichenbachiana	/	/																		
Viola canina				L									L			L	G		L	L
Viola arvensis													L							
Polygala vulgaris				/	L								L							
Hypericum androsaemum										L								G		
Hypericum calycinum									L											
Hypericum perforatum	/												G	L				/		
Hypericum tetrapterum	/			G										L	/	L	/	/	L	G
Hypericum humifusum	L	L		L	/	L	/	/	/	L	G		/	/	G	G			/	L
Hypericum pulchrum	L	L		/			G	G	G	L	/		L	/		L	G	G	/	/
Hypericum hirsutum	L													L					L	
Silene dioica	L	G	G													G			L	
Silene alba													L					/		
Silene vulgaris			L													L				
Lychnis flos-cuculi	/	G		L										/	/	L	L	/	/	L
Lychnis coronarius													G							
Saponaria officinalis																	G			
Cerastium holosteoides	/		/	/	/		L		/	/			/	/	/		L	/		
Cerastium glomeratum	/		L	/	/			I	I	G			G	/	G					
Myosoton aquaticum			G												G					
Stellaria media	L	L	G		/				G				/		/		/	/	G	
Stellaria holostea	/	/	/									/	/	/	/	/	/			
Stellaria graminea	/	G					/	L		G				/	/	/				
Stellaria alsine	G		/		G					/				/						
Sagina procumbens				/					I	/				G			L		L	L
Moehringia trinervia	/	/		/		G	G	G				G			G	G	/	G	/	
Spergula arvens.															L					
Montia fontana															G		L	G		
Chenopodium polyspermum				L	/					G		G	G		/		L			
Chenopodium album										L			L		G		L			
Chenopodium rubrum	L													L	/	L				
Beta vulgaris														L						
Atriplex patula										L			G		L		G			
Atriplex hastata					L			G		L		G	L	G	/	L	/			
Tilia platyphyllos				G															G	G
Tilia × vulgaris				L																
Malva moschata																			L	
Malva neglecta														L		L				
Geranium pratense																	/			
Geranium ibericum																	L			
Geranium pyrenaicum																		/		
Geranium dissectum					/				L				/	/	/	/	/	/	L	
Geranium molle																	L	L		
Geranium lucidum			G																	
Geranium robertianum	/	/	/	L	L		/	/	/	/	/	L	/	/			/	/	/	/
Tropaeolum majus										L										

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Oxalis acetosella	/	/	/	/	/	/	/	/	/	/	/		/	/						/
Oxalis europaea										L										
Oxalis articulata			G																	
Impatiens glandulifera			G												G	G	G	G		
Acer pseudoplatanus	/	/	/	/	/	/	/	G	G	G		G	G				G	/	/	G
Acer platanoides				/	G									G					G	
Acer campestre	/	/	G	/	/	/			G	/	/	/		G	/	G	G	/	/	G
Aesculus hippocastanum	G	/	/	G	/					G			G				G	/	G	/
Ilex aquifolium	/	/	/	/	/	/	/	/	/	/	/	/	/	/	G	G	/	G	/	/
Euonymus europaeus	/	G	/	G	/					/					/	/	G	/	G	
Rhamnus catharticus																	G		G	G
Frangula alnus	L									L			L							/
Parthenocissus tricuspidata																	L			
Genista anglica				/	L	L							L		L	L	L		L	/
Ulex europaeus				/	L			G	G	/			/	/	/	L	/	/	/	G
Ulex minor				/	L	L		L				L	/	L	/	/	/	L	/	/
Sarothamnus scoparius													L	L						
Medicago lupulina																L		L	L	
Trifolium micranthum									L									L		
Trifolium dubium			L	/			L		L		L		L			L		/	L	L
Trifolium repens	L		L	/	/		L		/	/			/	/	/	/	/	/	/	/
Trifolium fragiferum														L						L
Trifolium medium				/													L			L
Trifolium pratense			L	L	/				L	L			/	/	/	/	/	/	/	
Lotus corniculatus	L		L	/	L				L	G	/		/	/	/	/	/	/	/	/
Lotus pedunculatus		L	L	/	/	L	L			G	/	/	/	/	/	/	/	/	/	/
Ornithopus perpusillus									L											
Vicia hirsuta													/	L	L	/	/	/	/	
Vicia tetrasperma					G				L						/	/	/	/	/	
Vicia cracca				/	/									L	/	/	/	/	G	
Vicia sepium	L	/	L		/	G		L	L	/	L	L	/	/		L	G	L		
Vicia angustifolia				L	/				L	L			/		/	L	L	/	/	L
Lathyrus nissolia				L											/	L		/	L	
Lathyrus pratensis	L			L	/									G	/	/	/	/	/	/
Lathyrus montanus						L		L		/	L								/	/
Spiraea salicifolia														L				G		
Filipendula ulmaria	/		L	L										/	/	/	/	/		
Rubus idaeus			/	G					/	L				G	G		G	G	G	/
Rubus caesius	G																	G		
Rubus balfourianus					G										G		G	G		
Rubus fruticosus	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Rubus laciniatus													G							
Potentilla sterilis	/	/	G	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	G
Potentilla anserina	/	L		/	G	L	L	L	L	L	L	L	/	/	/	/	/	/	/	/
Potentilla erecta	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Potentilla anglica	G	L	L		/	G					/			L		/			L	/
Potentilla reptans	L			/	/	L	/	/	G	/	/		/	/	/	/	/	/	/	/
Fragaria vesca		L		/		L	L	/	L	/	/	/	/	/	L	L	L	L	L	/
Fragaria × ananassa										L										
Geum urbanum	/	/	/	/	/	/	L	G	G	/	/	G	/	/	/	G	/	/	/	/
Agrimonia eupatoria				/			L			G	L			/	/	/	/	/	/	/

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Agrimonia odorata	/			G									/	/	/	/	G	/	G	
Aphanes arvensis				L					L				L			L			/	
Aphanes microcarpa				G							L							G		
Rosa arvensis		G			/	/	G		G	/	G	/	G	/	/	G	G	/		/
Rosa rugosa																	G			
Rosa canina				G	/	/		/	L	/					/	G	G	/	G	G
Rosa rubiginosa					L															
Prunus spinosa	/	G	/	/	/	/	/	/	/	/	/	G	/	/	/	/	/	/	/	/
Prunus domestica					G											G	G	/		
Prunus insititia															G					
Prunus avium			G	G				/	/	G									G	G
Prunus laurocerasus							G	G		G			G						G	
Cotoneaster simonsii														L						
Crataegus oxyacanthoides	G					G		G		G	/	G	/	L						
Crataegus monogyna	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Crataegus oxyacanthoides × *monogyna*																G				
Crataegus prunifolia																				G
Sorbus aucuparia		L				G	/	G	G	G	G	/	G	/						/
Sorbus aria													G							/
Pyrus communis																G	G	G	G	
Malus sylvestris		L	/	/	/	G	G	G	/	/	/	/	/	L			G	/	/	/
Philadelphus cymosus										/										
Ribes sylvestre	/	G	G	G		G				/	/	G	/	/	G		/	/	/	/
Ribes nigrum			L		L					/		L	/	/			G	/		
Ribes uva-crispa			L	G														/	G	/
Peplis portula	L	L	L		/		/		/				G	/	G	/			G	
Epilobium hirsutum		/		/	/	G			/	/	G		/	/	/	/	/	/	/	/
Epilobium parviflorum								G			G			/						
Epilobium montanum	/		G	/	L		G	G	/	/	/	L	/	/		G		/	/	/
Epilobium adenocaulon						G		G	G	G	G	G	G	/	G	G	G	G	G	G
Epilobium tetragonum	G																			
Epilobium obscurum	/	/				G	L	G		L	/		L	/	G	/	L	L	/	
Epilobium palustre	L		L					G					L	L	G		/	L	G	
Chamaenerion angustifolium	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	G	G	/	/
Oenothera erythrosepala										L										
Circaea lutetiana	/	/	/	/	/	/	G	/	/	/	/		/	/			G	G	/	/
Myriophyllum spicatum														G						
Myriophyllum alterniflorum				L																
Callitriche stagnalis	/	/	/	G	/	/	/	/	G	/	G	G	/	/	/	/	/			/
Callitriche intermedia	G													G			G			
Thelycrania sanguinea	/	G	L	/	/	G	/	/	/	/	/	/	/	/	G		/	/	/	/
Hedera helix	/	/	/	/	/	/	/	/	/	/	/	/	/	/	G	/	/	/	/	/
Hydrocotyle vulgaris		L											/	L		L	L		/	/
Sanicula europaea		G	G		/		/	G	/	/	/	/	/	G						G
Chaerophyllum temulentum																	L			
Anthriscus sylvestris		L	G							/			/	L	L	L	/	/	/	
Torilis japonica				/	L				L	L			/	/	/	/	/	/	/	/
Conium maculatum								G							/	/	/	/		
Apium nodiflorum	L	L	L										L	/	/	/	/	/		
Apium inundatum													L	/				L		
Conopodium majus			G				L			L			G	L			/		G	/

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Pimpinella saxifraga				/											G	L	L	L	L	
Aegopodium podagraria			/	G	G				G	/			/	/	/	G	/	/	/	
Oenanthe fistulosa																L				
Oenanthe crocata			L												G		L			
Aethusa cynapium																	L		G	
Silaum silaus				L	L									L	/	/	/	/	/	G
Angelica sylvestris	L		L	/	/	G		L	G				G	/	/	/	/	/	/	/
Pastinaca sativa													/	L	/	L	L	/	/	/
Heracleum sphondylium	/	/	/	/	L				L	/			/	/	/	/	/	/	/	/
Bryonia dioica	/			L	L					L					/	/	/	/	/	/
Mercurialis perennis	/	L		/	L															
Mercurialis annua					L															
Euphorbia peplus			G	L						/			/	/			L	L	/	
Euphorbia amygdaloides																			/	
Euphorbia robbiae										G										
Polygonum aviculare			L	L	/					/			/		/	L	/	/		
Polygonum persicaria		L		L	L	G			G				/	/	/	/	/		G	
Polygonum lapathifolium									G					G	/					
Polygonum hydropiper	/	/	/	/	/		/	/	/	/	G		/	/	/	/		/		
Polygonum convolvulus													L				L			
Polygonum cuspidatum										/										
Rumex acetosella				L			L				L		L		/				/	/
Rumex acetosa	L	L	L	/	/	/		/	/	/	L	/	/	/	/	/	/	/	/	/
Rumex crispus				L									/		G	/		/		
Rumex obtusifolius	L	L	/	/	L					/			/	/	/	/	/	/	/	/
Rumex sanguineus	/	L	/	L	/	L	/	L	/	/	L	L	/	/	/			/	/	/
Rumex conglomeratus	/			L	/		/	L	/					/	/	/	/	/	/	/
Urtica urens													L				L			
Urtica dioica	/	/	/	/	/				/	/	G		/	/	/	/	/	/	/	/
Humulus lupulus			L	/										L	/			/	G	
Ulmus glabra																	G			
Ulmus procera	/	/		/	L									L	/	/	/	/		
Betula pendula	/	/	/	/	/	/	/	/	/	/	/	/	/	/	G	G	/	/	/	/
Betula pubescens	G	G	G	G	G	G	G	/	G	G	G	G	/	G	G	G	G	G	G	/
Alnus glutinosa														G				G		
Carpinus betulus	/	/		/	/	G	G				G	G	L						G	
Corylus avellana	/	/	/	/	/	/	/	/	/	/	/	/	/	/	G	G	/	G	/	/
Fagus sylvatica	/	/	/	/	/	G	/	/	G	/	G	G	/		/		/		/	/
Castanea sativa	/	G	G						G	/		G					G			
Quercus cerris	/	/	/	/	/	/	/	/	/	G	G	G	/	G	G			G	G	G
Quercus robur	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Populus alba																		/		
Populus tremula	/	G		G	/	/	/	G	/	/			/	/			G		/	/
Salix fragilis	/	G		L	/									/		/	/	/	/	
Salix viminalis															/		G	/		
Salix caprea	/	/	/	/		/	/	/	/	/	G	/	/	/			G	/	/	/
Salix cinerea	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Salix aurita						G													G	
Calluna vulgaris				L									L	L					L	/
Erica tetralix				G																
Erica cinerea															G					G

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Primula veris		/			L											L		/		
Primula vulgaris	/	/	/	/	/	L	/	L	/	/	/	/		/	G		L	/		
Lysimachia nemorum	/	/	G	L			L	/	/	/	/			G		G			L	/
Lysimachia nummularia		L	L		L				L	L			/	/	/	/	L	/	L	G
Lysimachia punctata			G										L					G		
Anagallis arvensis				L						/			L		L		L	L		
Anagallis minima																			L	
Fraxinus excelsior	/	/	/	/	/	/	/	/	/	/	G	/	G	/	/	/	/	/	G	G
Ligustrum vulgare	/	/		L						L					/			G		
Ligustrum ovalifolium	G		G							/					G					
Vinca minor				/	G					G										
Vinca major			L												L			L		
Centaurium erythraea				L									L		L			G		
Symphytum officinale					/											/			G	
Symphytum × uplandicum					/											L				
Symphytum orientale																		G		
Pentaglottis sempervirens			G							/										
Pulmonaria officinalis				G										G						
Myosotis scorpioides			L		G									/	/	L	/			
Myosotis secunda														L		L				
Myosotis caespitosa	/													/	G	G	/	/		
Myosotis sylvatica														L		G	/	/	G	
Myosotis arvensis	L			L									G		/	/	L	/		
Myosotis discolor															G	G	L	/	L	
Lithospermum officinale					L															
Convolvulus arvensis														G				/		
Calystegia sepium				L	L							G	/	L	/	/	/	/	/	
Calystegia pulchra			G																	
Calystegia silvatica			G							L										
Hyoscyamus niger															L				L	
Solanum dulcamara	L	/	/	/	/				L	L	/		/	/	/	/	/	/	/	L
Solanum nigrum				L	L	G	G						L		G				L	
Solanum tuberosum			G														L			
Lycopersicum esculentum													L							
Verbascum thapsus													L	L						
Linaria vulgaris																L				
Chaenorhinum minus														L						
Cymbalaria muralis													L							
Scrophularia nodosa	/	G	L	/	/	G				/	/				G			/	/	L
Scrophularia aquatica	/			/					L					/	/	/	/	/	/	L
Digitalis purpurea	/	/	/	/	L	L	L	/	G	/	L			/						/
Veronica beccabunga		L	L							L				/	L			/		
Veronica scutellata														/			L			L
Veronica officinalis	L			/	L	G		G	/	/		G	/	G	/	L		L	L	
Veronica montana	G	/	G	L					L	/										G
Veronica chamaedrys	/	G	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Veronica longifolia																	L			
Veronica serpyllifolia	L	L		/	/		/	L	L	/			/	/	/		L	/	/	
Veronica arvensis													G	L	/	L		/	/	L
Veronica hederifolia			/	G													G		G	
Veronica persica				L						L			L	G	L					

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Veronica agrestis													L	L			L			
Veronica filiformis										/			G	G	G		L			
Pedicularis sylvatica									L				L		G					
Euphrasia officinalis agg				L									L	L					L	L
Euphrasia anglica				L											G					
Odontites verna					/								/	L	/	/	/	/	L	L
Verbena officinalis					G	L								G					L	
Mentha pulegium																	L			
Mentha arvensis				G						L			/	/	/	/	/	/		/
Mentha × *verticillata*	/													/		L				L
Mentha aquatica			L							L				/	/	/	/	/	/	/
Mentha spicata			G																	
Mentha longifolia																	L			
Mentha × *niliaca*																	L			
Lycopus europaeus	/	L	/					L					G	/	/	/	L		G	/
Thymus pulegioides				L											L	L		L	L	
Clinopodium vulgare																		/		
Melissa officinalis										L										
Prunella vulgaris	/	/	/	/	/	/	/	/	/	/	G	G	/	/	/	/	L	/	/	/
Stachys palustris														/	/	/	/	/		
Stachys sylvatica	/	/	/	/	L	L				/	/		/	/	/	/	/	/	/	/
Stachys × *ambigua*															L					
Betonica officinalis	L			L	G	/	L	/	/	/	/	/		/	/	L	L	L	G	/
Ballota nigra																	G			
Galeobdolon luteum			G																	
Lamium purpureum									G	L			G	/	L	L	/	/	G	
Lamium album	L				/					/			G	/	/	/	/	/	/	
Lamium maculatum													G				G	G		
Galeopsis tetrahit										/			L		/	G	G	/		
Glechoma hederacea	/	/	/	/	/	L	L		/	/	G		/	/	/	/	/	/	/	/
Scutellaria galericulata														/						
Scutellaria minor	/	/				/	/	/	G		/		G	L						L
Teucrium scorodonia			G	L				L	L				L							
Ajuga reptans	/	/	/	/	/	G	/	/	/	/	/	/	/	/		L		/	/	/
Plantago major	L	G	/	/	/		/	/	/	/			/	/	/	/	/	/	/	/
Plantago lanceolata	L		L	/	/					G	L		/	/	L	L	/	/	/	L
Campanula rotundifolia				/							L		G	L	/	L	L	L	/	L
Galium cruciata																		G		
Galium odoratum			G																	
Galium mollugo														L				L		L
Galium verum															L	/		/		
Galium saxatile	/	L	L	/	/	G	L	G			/	G	/	/	/	/	/	/	/	/
Galium palustre	/			L			L						/	/		/	/	G	/	L
Galium uliginosum			L		/	/		/	/		/		/	/	/	/	/	/	/	/
Galium aparine	/	/	/	/	/	/		L	/	/	G		/	/	/	/	/	/	/	/
Sambucus nigra	/	/	/	/	/	/		/	/	/	G	/	G	/	/	/	/	/	/	/
Viburnum opulus	/							L	G		G	G	L	G			G		G	G
Symphoricarpos rivularis																	G	L		
Lonicera periclymenum	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Adoxa moschatellina	L	G																		
Valeriana officinalis														L	/	G		G		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Dipsacus fullonum	G													G	/	/	G	/		G
Succisa pratensis				/	/	L	/	L	/	/			/	/	/		/	L	/	/
Helianthus tuberosus																	L			
Bidens cernua			/	L	L					L			L	/	L	L		L		
Bidens tripartita														/	L	L				G
Galinsoga parviflora													L							
Senecio jacobaea				L					/	L				/	/	/	/	/	/	/
Senecio erucifolius				/					/	L			/	/	/	/	/	/	/	
Senecio squalidus			G							G							L			
Senecio sylvaticus				G	G			G	G				L	L	G	G				L
Senecio viscosus																G				L
Senecio vulgaris						L		G	G		G		/	/	/	G	/	L		
Doronicum partlalianches													G							
Tussilago farfara					L				L				L			G	/	/	/	L
Calendula officinalis					L															
Inula conyza															L					
Pulicaria dysenterica				L						L			/	/	/	/	/	/	/	/
Gnaphalium sylvaticum				L																
Gnaphalium uliginosum	/		/	/	/	G	/	L	/		/	G	/	G	/	/		/	/	L
Solidago canadensis					L					L			L				L	L		
Aster lanceolatus																	L			
Aster novi-belgii																		G		
Conyza canadensis								G	G		G									
Bellis perennis				/						/			/	/	L	/		/	L	L
Achillea millefolium	L		L	/	/				L		L		/	/	/	/	/	/	/	G
Achillea ptarmica	L			L	L		L		L				/	/	/	/	/	/	/	/
Tripleurospermum maritimum				L	L					/			L		L	L	G	L		
Matricaria recutita					L										L					
Matricaria matricarioides			/		/					L			/	L	/	L	/	L		
Chrysanthemum leucanthemum					L				L		L		G	/	L	L	L	/		
Chrysanthemum parthenium													/							
Chrysanthemum maximum			G										G							
Chrysanthemum uliginosum																	L			
Chrysanthemum vulgare										L			G	/						
Artemisia vulgaris														/			G	/	/	G
Arctium lappa				/					L					L	/	G	G	G		
Arctium minus			G	/	L					L			/		/			/	G	
Cirsium vulgare	L			/	G				L				/	/	/	/	L	/	/	/
Cirsium palustre	L	L	L	/	/	/	L	L	/	/	/	/	/	/	/	/	/	/	/	/
Cirsium arvense			L	/	/				G	/			/	/	/	/	/	/	/	/
Cirsium dissectum													L						L	/
Centaurea nigra	L		L	L	/				L		/		/	/	/	/	/	/	/	/
Serratula tinctoria						L													G	
Lapsana communis		/	/	L	L		G		G	/	/		/	/	G	/	/	/	/	
Hypochoeris radicata		L	/	/					/	/	/		/	/	/	G	L	/	/	/
Leontodon autumnalis	L			/									/	L	G	G	G	G		L
Leontodon hispidus				L					L		L			L	L			/		
Tragopogon pratensis					L									/	L			/	L	
Lactuca sativa										L										
Lactuca serriola																L				
Mycelis muralis				L										G						

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Sonchus arvensis				G						I			I	/	/		I	/		
Sonchus oleraceus				L				G	G		G			/	G		G			
Sonchus asper				L					G	I			L		/	L	/			
Hieracium sect. *umbellata*									I	/			G		I				G	G
Hieracium sect. *sabauda*		G							I	/										
Hieracium pilosella				/			I		I	I		I	I	I	/	L		I	I	I
Crepis capillaris								G	I	G	G		G				G	/	·	
Taraxacum officinale	L	/	/		/	G	L	L	·	/	/	L	/	/	/	/	/	/		/
Taraxacum laevigatum															G					L
Alisma plantago-aquatica	L	L	/	L	L	L		L			L			/	/	L	L	L	L	L
Elodea canadensis			G											G						
Lagarosiphon major													G	G						
Potamogeton natans	L		/	L									G	/			L			
Potamogeton pusillus														G						
Potamogeton obtusifolius														G						
Potamogeton crispus		L												L						
Hemerocallis fulva																G	L			
Asparagus officinalis															·					
Ruscus aculeatus	/	·	/	/		·							·	/		G			/	
Ornithogalum umbellatum																		G		
Scilla siberica																		G		
Endymion nonscriptus					·	/									G	G	·			/
Endymion nonscriptus × *hispanicus*																			G	
Allium vineale																	G			
Allium ursinum																			G	
Juncus tenuis	I													G				G	L	
Juncus bufonius	I						I						G			G	·		·	
Juncus inflexus	I						I		I	I					/		/			
Juncus effusus		/									G	·		·	/	/	/	/		/
Juncus conglomeratus				·	/	L			·				G	L	/	/	/		/	·
Juncus acutiflorus				·	·								L	/	G		·	·	·	
Juncus articulatus		L		L										·			G			
Juncus bulbosus		L												G						·
Luzula pilosa								G	G				/							
Luzula forsteri		G											G							G
Luzula campestris	/	I	G			G		G	I	I				/			L	L		
Luzula multiflora	G		G										G				G			G
Leucojum aestivum																	G			
Galanthus nivalis																	G			
Iris foetidissima																		G		
Iris pseudacorus										I							/			
Crocosmia × *crocosmiiflora*			G																	
Tamus communis	I	/	·		/		·	I	I			I							G	
Cephalanthera damasonium																				G
Epipactis helleborine																			C	G
Epipactis purpurata										I										
Listera ovata																	I	I	I	
Dactylorchis ericetorum																				
Dactylorchis fuchsii			G	I												I	I		G	
Dactylorchis praetermissa																		G		
Dactylorchis fuchsii × *praetermissa*																		G		

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Arum maculatum	/	G	G	/	G				/		/		G	/	G	G	/	/	/	G
Lemna polyrrhiza			L										G	G						
Lemna trisulca			L											/		L	L			
Lemna minor	L	L	/								L		/	/		L	/			
Sparganium erectum													L	/		L	L			
Sparganium emersum														L			L			
Typha latifolia				L										/			L			
Eleocharis palustris														L		L	L			
Isolepis setacea														G			G			L
Eleogiton fluitans		L																		
Carex demissa		L					L							G			L		L	L
Carex sylvatica	/	/	G			G	/	G	/	/	/	/	G	G					/	
Carex pendula			G	G										G				/		G
Carex strigosa	G																			
Carex paniculata														G					L	/
Carex flacca				L	/	L	L				/		L	L	/	L	/	/	I	L
Carex pilulifera	G																		G	/
Carex caryophyllea													L							
Carex hirta	/			/	/	.	I					/	/	/	/	/	/	/	/	/
Carex nigra	I			L	G									L	G		/	G		L
Carex otrubae	L	G			/									/	/	/	/	/	.	
Carex divulsa															G			G		
Carex spicata					G									G		L		G		
Carex remota		/	G	I						G	L		G	/		L	L	L		G
Carex ovalis	L		G	/	/		G	I.	L					.		/	/	/	/	/
Molinia caerulea				L								L	/				L	L	/	/
Sieglingia decumbens				L	L	L		L	/	G					G		/	L	/	/
Glyceria fluitans									G				G							
Glyceria plicata															L	L				
Glyceria declinata	G	G	/						G		G									
Festuca arundinacea									L		L		G						L	
Festuca gigantea	/	/	G	/						G			G		G				G	G
Festuca rubra			L	/	/	G	G		L	G			/	/	/	/	G	/	/	/
Festuca ovina	L			L									L						G	L
Festuca tenuifolia																				G
Lolium perenne	L	G	/	/	L		L		G	G			/	/		/	/		/	
Lolium multiflorum		L	L						G							L				
Vulpia bromoides				/					I		L					L		I.		
Poa annua	/	/	/	/		G		G			.			/	/	/	/	/	/	/
Poa nemoralis		.	/							L		L		G			G	G		
Poa compressa															G					
Poa pratensis	L								I.		L			L			/		/	
Poa trivialis	.		/	/		L							G	/	/					G
Dactylis glomerata	L									.				/	.	/	/			
Cynosurus cristatus					L					G		L		L	L	L	L	L	L	L
Briza media													L			L	L		L	
Melica uniflora	L																			
Zerna erecta																		L		
Zerna ramosa		G	/			L					L		G	G		G		/	G	
Anisantha sterilis	L		L	L						L				L	/			/	/	
Bromus mollis					L														L	

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Bromus commutatus															L					
Brachypodium sylvaticum	/	/	/	/	/	L	/	/	/	/	/	/	/	/	G	G	/	/	/	/
Brachypodium pinnatum				L																
Agropyron caninum		/								/										
Agropyron repens			G		/								/		G	G	G	/	G	
Hordeum secalinum					/								G		/	L	G	/	L	
Hordeum murinum				/						L			G		L	L		G		
Koeleria cristata											L				L	L	L			
Trisetum flavescens				L	L						L		G	L		L		L	L	
Arrhenatherum elatius	/	G	/	L	/	/	/	/	/	/		/	G	/	/	/	/	/	G	
Holcus lanatus	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Holcus mollis		G	G							G			G	G					G	G
Deschampsia caespitosa	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/	/
Deschampsia flexuosa							/													L
Aira praecox				L																
Aira caryophyllea				L																
Agrostis canina	L	/	/	/	/	/	/			/			/	/	/	L	/	/	/	/
Agrostis tenuis				/	G		/	G	/	/	/	/	/	G	G	/	/	/	/	/
Agrostis gigantea															G			L		
Agrostis stolonifera			L		/				G		L		/	/	/	G	G	/	/	
Apera spica-venti													L							
Phleum bertolonii				/	L				L	G	L		/	L	L			L	/	
Phleum pratense																		L	L	L
Alopecurus myosuroides					L															
Alopecurus pratensis	/		L	L	/	L			/		L		/	/	/	/	/	/	/	
Alopecurus geniculatus	L				G									/	G	/		/		
Alopecurus aequalis														G						
Anthoxanthum odoratum	/		/	/	/	/	/	L	/	G	/	/	/	/	/	/	L	/	/	/
Phalaris arundinacea				G	L								L	L	/					
Nardus stricta																				/

London Nature Conservation Committee
Annual Report 1980

'But what does the London Nature Conservation Committee do?' is a question which London Natural History Society members and others must often ask. It is a question to which it is easier to give specific areas of our work rather than general answers. Given limited resources, manpower and time, the London Nature Conservation Committee has tried in 1980, as in previous years, to be a watchdog for London's threatened wildlife habitats. As always there have been some successes and some failures but while the Committee does not have the charisma of a household name such as Friends of the Earth or Greenpeace, it beavers away quietly in the background often without recognition of what it has achieved over the years.

One of our most important roles is as an information exchange point and referral agency — shared experience can benefit someone about to take up the cudgels on behalf of a new group or site. Many telephone calls about a particular area are passed on to the Nature Conservancy Council or the local Nature Conservation Trusts who are often the most appropriate agencies to deal with the problem. Similarly if the Nature Conservancy Council or Trusts require support the London Nature Conservation Committee will either provide information, records etc. or write a letter objecting to a particular detrimental proposal. London Nature Conservation Committee representatives can also play an important role when District or Local Plans are being formulated by Borough Councils as very often they have unknown and untapped expertise. Additionally, the London Nature Conservation Committee is represented on such groups as the Lee Valley Conservation Group, the Colne Valley Liaison Committee, and the Water Panel of the Regional Council for Sport and Recreation, thus making an important input on a wider scale.

One of the main threats to sites this year has been from proposed gravel working, with three sites on London's urban fringe coming under fire. The situation is all too familiar for Staines Moor Site of Special Scientific Interest, for which conservation organisations and natural history societies fought ten years ago. In 1980 another public enquiry was held and resulted in a reprieve for the area. A public enquiry on another site — Walthamstow Marshes — will be held in 1981 since the Lee Valley Regional Park Authority appealed against a refusal for gravel extraction given by the Greater London Council. The third site, Frays Meadows in the Colne Valley, has also been the subject of heated debate over its future with naturalists hoping to make it a Local Nature Reserve while others prefer to see it another area for gravel working.

Other sites taken up by the Committee include Weald Wood in the London Borough of Harrow; Beddington Sewage Works in the London Borough of Mitcham; M25 routes; Ruxley Gravel Pits; Chelsea Creek; Redbridge Sewage Works and many others throughout London. In total the London Nature Conservation Committee met 5 times under the chairmanship of John Montgomery, Chairman of the Surrey Trust for Nature Conservation, who has made available the very comfortable and splendid meeting room at Salters' Hall in the City. Committee members have remained much the same except that Philip Masters replaced Marian Whittaker as the British Trust for Nature Conservation Volunteers' representative; Albert Watson attends now on behalf of the Kent Trust for Nature Conservation; and a new member will be provided in 1981 by the East End Wildlife Group.

All London Nature Conservation Committee activities have taken place against background talks on a proposed Environmental Trust for London to which debate London Natural History Society, London Nature Conservation Committee, Nature Conservation Trust representatives and others have contributed. It seems likely that once the Trust has been established the work of the London Nature Conservation Committee will be transferred to the new organisation. If 1981 sees this happen an era will be established for the protection of London's wildlife while in the background an old Committee having done its job will disband. The London Nature Conservation Committee hopes the new Trust will seek advice from its members where possible and continue the network that has existed among local naturalists in the past. If the old can be married with the new, the Trust will be based on a firm structure for the future.

SUSAN JOY
Secretary, London Nature Conservation Committee.

Book Review

The Heyday of Natural History, 1820 – 1870. By Lynn Barber. 320 pp. Jonathan Cape, London. 1980. £9.50.

Most of the local natural history societies in England and Wales were formed in the late nineteenth century to act as communication centres for the professional and amateur natural historian; towards the end of the century the professional natural historians tended to specialise in one small part of the subject and subsequently became divorced from the amateur element in these societies.

This book covers a period during which there was a great burgeoning of the literature of natural history and it is a very readable account of the rapid rise in popular interest. A combination of cheaper print materials so that popular books came within the means of middle-class, and even some working-class, Victorians, and an increase in the number of people with leisure to devote to worthy pursuits, made all this possible.

Lynn Barber has used much biographical material to make her story live, and the characters are depicted as men with strong personalities and firm views. The mid-nineteenth century saw the development of ideas, and the description of systematic studies, by such men as Linnaeus, Buckland, Sedgwick, Murchison, Darwin, and Huxley, all of whom receive considerable attention. However, much of the basis of Victorian natural history was collecting, and in this activity female naturalists were notable, e.g. Mary Anning (fossils) and Mrs Griffiths (algae). Many women naturalists turned to writing natural history books for children, e.g. Mrs Gatty's *Parables from Nature*, but these often aimed at a high moral tone and had only a small element of natural history. The author has produced a well-written account of the social and historical backgrounds to which these naturalists made their various contributions. The book is well illustrated with portraits, colour plates, and reproductions of contemporary cartoons.

JOAN E. HARDY

Botanical Records for 1980

by R. M. BURTON*

Summary

Principal botanical records for the London area in 1980 are given. They include *Carex* × *subgracilis* in S. Essex, *Polygonum mite* in Herts, *Carex divisa*, *Dryopteris borreri*, *Equisetum* × *litorale* and *Hieracium scotosticum* in Middlesex, all new or otherwise long extinct in their respective counties.

Introduction

This paper continues an annual series of reports on the more important botanical discoveries made in the recording area of the London Natural History Society, which is approximately circular, 64 km in diameter with its centre in the City of London. The area is divided into small squares numbered according to a system explained by Sandford (1972). For ease of cross-referencing with other publications on the flora of the area the paper is subdivided on the vice-county system devised by Watson (1873). The scientific names used are those recommended by Dandy (1958), omitting the authorities for the names, except for those alien species not included in his list.

The spring months of 1980 were remarkably dry. Vernal ephemeral plant species had germinated well but made poor growth. The middle of the summer was notably drear but this does not appear to have dampened the enthusiasm of London botanists whose level of success remains high.

Records

V.C. 16 West Kent

Again the best finds in our part of Kent have been made by J. R. Palmer, who has spent a lot of time examining the Thames shore from above Erith (58T00) to a long way out of our area looking at plants which have come up from seeds drifting down stream. Some of these can be traced back to larger populations above London (*Angelica archangelica, A. sylvestris, Lythrum salicaria*), others (*Ambrosia trifida* L., *Coriandrum sativum, Helianthus annuus* L., *Ipomoea hederacea* Jacq., *Xanthium echinatum* Murr.) have come from the oil-milling works referred to in his paper (1977). Repeated observation will be necessary to ascertain which of these become naturalised along the Thames. He found a patch of *Hippophaë rhamnoides* forty feet long high on a sandy hill south of Alkerden Manor Farm (57T82); this was 'definitely not planted' and it should be possible to work out how long it takes for so extensive a patch to grow from a single bird-sown seedling. Aliens on a rubbish tip at Stone (57T64) include *Ononis alopecuroides* L., which is new to our records. Mr Palmer attributes the introduction of *Phalaris aquatica* L., which was abundant in cabbage fields on Dartford Marshes (57T46) and *Fagopyrum tataricum* Gaertn., and other more often seen aliens in a root crop at Fawkham (56T86) to the previous use of the land for raising seeds to be fed to game birds. The *Phalaris* is a perennial grass which can be expected to persist if it gets to places where it will be allowed to, in the same way that the only *Sorghum* which persists in this country is the perennial *S. halepense* (L.) Pers., of which Mr Palmer reports a large clump on the landward side of the river wall on Erith Marshes (48T80). The aliens he lists from an industrial dump at Greenhithe (57T84) include *Eragrostis cilianensis* (All.) Vign.-Lut., *Panicum capillare* L., and *P. dichotomiflorum* Michx.; late in the season he and E. J. Clement found a growing ground-nut plant *Arachis hypogea*

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L., there. Another perennial grass which can persist is *Agrostis scabra* which was abundant in sand spread to cover a rubbish dump at Stone (57T64). *Allium sphaerocephalon* on Stone Marshes (57T64) is a garden escape new to our records. *Echniops sphaerocephalus* on the river wall at Littlebrook (57T46) may also be a garden escape though the glandular hairs on its foliage clearly distinguish it from the globe thistle most commonly grown. There is an even larger population of the same species in a sandpit on the west side of Dartford Heath (57T02). Nearby in thick scrub Mr Palmer found a very extensive colony of *Vicia tenuifolia.* Dartford Heath has the most important records of native plants among the many selected here from the long list he supplied. Its population of *Genista anglica* includes a colony of about 300 plants, much the largest in England south-east of London. In 1980 he found *Pedicularis sylvatica* and *Sieglingia decumbens;* it is remarkable that these have been overlooked in this locality, the former for 30 years, the grass for much longer. At our meeting on 14 June he also found a prostrate plant of *Sarothamnus scoparius* with leaves shaggy with spreading hairs, the characters of subsp. *maritimus.* Those at the meeting also saw *Trifolium subterraneum* and *T. glomeratum* in a new locality discovered then.

They did not however see *Trifolium ornithopodioides* which was reported on Dartford Heath (57T02) by Mrs J. Pitt. Other finds of hers in 1980 include *Spiranthes spiralis* on a chalk slope near Cudham (46T40) and *Platanthera chlorantha* north-west of Westerham (45T24). The former has always been a rare orchid in the London area and the latter is getting to be almost as scarce. She was more pleased to see one plant of *Eriophorum angustifolium* in Keston Bog (46T04); this was last seen about twelve years ago and it was feared that cotton-grass should be added to the long list of bog plants which have become extinct there.

Nor did they see *Carex muricata* or *Hypericum humifusum* which I found myself in a different part of Dartford Heath (57T22) on the same day, as well as another group of *Trifolium glomeratum.* Also in Kent in 1980 I saw many hundreds of snowdrops *Galanthus nivalis* in a wood near Knockholt Pound (45T68); it must have been naturalised here for many years but was inaccessible to the public before the opening of the North Downs Way, a long distance footpath. In the River Cray below Foots Cray (47T80) where we had gone to confirm the continued presence of *Blysmus compressus,* Mrs E. Norman, Dr G. S. Joyce and I found a detached piece of *Potamogeton obtusifolius;* there is no telling where this had drifted from. Mrs Norman later drew my attention to *Papaver lateritium* more or less naturalised in Farmingham churchyard. The meeting I led on 5 July produced good quantities of *Torilis nodosa, Geranium rotundifolium, Ranunculus sardous, Zannichellia palustris* and *Carex divisa* in various habitats between Slade Green, Erith and Crayford Ness (mostly 57T26). Two plants of *Puccinellia rupestris* by a slightly brackish ditch may well be in the very place where it was seen by J. E. Lousley and others in 1951 (Lousley 1952). It is hard to guess how the alien grasses *Bromus inermis* and *Hordeum jubatum* got into the sward in the lee of the river wall here.

A site near the railway at Forest Hill (37T42) was twice visited by Mrs J. E. Smith and Mrs S. Wenham at the invitation of the London Borough of Lewisham which owns it. It has mixed deciduous woodland, hawthorn thicket and grassland. The influence of neighbouring gardens on the flora is very obvious, with wind or bird sown species like *Onopordon acanthium* and *Prunus domestica* appearing either casually or as naturalised aliens. They found a young plant of *Polystichum setiferum* and possibly native *Allium ursinum* and *Viola riviniana.*

V.C. 17, Surrey

Relatively few interesting records from Surrey have reached me this year. P. J.

Strangeman sent details of *Dactylorchis* on Epsom Common (16T80) which is at least partly *D. maculata*. R. M. Parker found about 25 plants of *Onopordon acanthium* on a tip on the Sutton by-pass (26T44). Miss M. E. Young reports *Hypericum humifusum* colonising the sides of a recently dug ditch in Richmond Park (17T82). J. M. Montgomery added *Carex divulsa, C. otrubae, C. spicata* and others to his already long list from Ham Moor (06T44). I found *Hieracium diaphanum* as a garden weed by a prefab in Peckham (37T26) and on a patch of untrimmed grass east of there near Horders Road (37T46) came across *Medicago arabica* and two plants of *Carum carvi*. Our meeting of 30 August confirmed that *Sium latifolium* is hanging on at Runnymede in probably its only locality left in our area and found *Stellaria palustris* farther south there than was previously known (07T00). On his way there Dr A. C. Leslie found *Trifolium aureum* in a field south-east of Egham station (07T00). Our meeting of 24 August confirmed the presence of several well-known species in the neighbourhood of Reigate Hill but was unable to spot *Salvia pratensis*. An unexpected discovery was *Sieglingia decumbens* at the back of Colley Hill (25T42). After the meeting K. Page and B. R. Radcliffe succeeded in locating the one bush of *Mespilus germanica* at Redhill (25T80) where it was first found by J. S. Mill in 1831. The plant is very different from the medlars still available in commerce. Earlier in the year Mr Page, Mr Radcliffe and others found *Lathyrus aphaca, L. hirsutus* and *Vicia lutea* on Wimbledon Common (27T00), an odd assortment of vetches which may have been introduced together when there was tipping on this site years ago. Nearby Mr Page saw one bush of *Rosa tomentosa*. The same rose was seen at the edge of a copse near Burgh Heath (25T28) by Mr Radcliffe, who also reports a surprising *Orobanche hederae* in a shady garden in Sutton (26T82) and a sapling *Acer saccharinum* L., in woodland on Wimbledon Common (27T20) about 100 metres from a mature tree of the same species which may well be its parent. Dr R. D. Meikle was taken to look at willows at Chertsey Mead (06T66) and identified or confirmed *Salix* × *forbyana, S.* × *mollissima* (*S. hippophaefolia* Thuill.), *S.* × *rubra* and *S. triandra*. *S purpurea* is also in the area; it is a parent of *S.* × *rubra* which in turn may be involved in the origin of *S. forbyana*, suggesting that these osiers might have arisen naturally here, or else were introduced together from a common source.

V.C. 18, South Essex

Introduced species excepted, quite the rarest plant to have come to light in the London area in 1980 is the sterile hybrid of *Carex acuta* and *C. acutiformis* which B. Wurzell recognised in Walthamstow Marshes (38T46). Large areas are covered by a dense growth of sedges in which the hybrid is mixed with *C. acuta, C. disticha* and *C. hirta*. The antiquity of this unique community is attested by the fact that the hybrid occurs on both sides of the railway built across the Marshes in the middle of the last century, a fact whose significance will no doubt play a part in the continuing efforts to protect them from wanton development. The construction of the railway may well have been the occasion when *Equisetum* × *litorale* first appeared at Walthamstow; it is now the commonest horse-tail there. Other 1980 discoveries on the same site were a dense colony of *Ophioglossum vulgatum* and a plant of *Heracleum mantegazzianum* × *sphondylium*.

Many excellent finds are again attributable to B. L. Coombes. *Cardamine amara* was abundant at two sites near Kelvedon Hatch (59T68) and one north-east of Pilgrims Hatch (59T86). He found quite a lot of *Carex strigosa* growing with *C. pendula* near Stapleford Tawney (59T08). In an area of wet pasture and alder wood (59T**) he reports a group of plants of *Dactylorhiza incarnata* which is already in danger from trampling by cattle and might be subject to other risks if I give too much detail of the locality. In the centre of a small complex of marshes and ponds near Bishops Hall (49T64) he found over a hundred plants of *Osmunda regalis*, of various ages, indicating that the plant is extremely well

naturalised, if not native; other plants from this site are a large group of *Juncus subnodulosus*, a scattering of *Mimulus guttatus*, plenty of *Bidens cernua*, *Oenanthe aquatica*, *Peplis portula* and an alien *Sagittaria*, probably *S. latifolia*. Much of South Essex is on clay soils which are often considered botanically unattractive; Mr Coombes has demonstrated that this is unjust and that a search in the less disturbed sites can produce plants like many of those mentioned which had been wrongly considered very rare or extinct. In Holdens Wood (59T80) he found *Carex laevigata*, not previously recorded in Essex for the London Natural History Society, and *Thelypteris palustris*. Both these species indicate the antiquity of this damp woodland which is presumably the 'Warley Woods' from which Miss Ellen Willmott took the marsh fern into cultivation (Shenstone 1912). Mr Coombes found *Epilobium palustre* in Brizes Wood (59T68) and *Nymphoides peltata* in Larch Wood (59T02). The habitat in the latter was a small lake re-created by the repair of an earth dam some years before, and it is at least possible that this attractive aquatic, exinct as a native plant in Essex, was introduced deliberately by anglers, although it is a nuisance to them now. *Scirpus maritimus* was also here. *Calamagrostis epigejos* and *Euphrasia nemorosa* were in fire breaks in a wooded part of Thorndon Park (69T00). He found *Menyanthes trifoliata* in a gravel pit and a natural shallow valley adjacent to it at Coopersale (40T62) in a new locality further north than those previously known.

Mrs P. S. Swettenham sent me long lists of plants seen by herself and Mrs S. Aber in South Essex. By and in Berwick Pond (58T42) they noted *Lemna polyrhiza*, *Lotus tenuis*, *Lysimachia vulgaris*, *Rumex palustris* and *R. maritimus*. The last is generally the rarest of our native docks but they also saw it near Wennington (58T20). *R. palustris* and the *Lysimachia* were also by the River Ingrebourne at South Hornchurch (58T22). Nearby on ground where there was once a refuse tip they saw many clumps of the pretty alien *Vicia tenuifolia*, also *Atropa belladonna*, *Geranium rotundifolium* and *Melilotus indica*. In an unpromising area of arable land west of 'The Harrow', Bulphan (68T24) they found *Ornithogalum umbellatum*, *Lithospermum arvense* and *Scandix pecten-veneris*. The last has not been reported in our part of Essex for over 30 years and the gromwell is almost as rare.

V.C. 20, Hertfordshire

Our best 1980 Herts records are also those contributed by Mr Wurzell. Two tiny plants of *Polygonum mite* by a flooded gravel pit at Rye Meads (31T80) are the first noticed anywhere in this county for a very long time. Other plants he and K. A. Roberts found in that area include *Bidens cernua*, *Calamagrostis epigejos*, *Elodea nuttallii* which has increased greatly in the Lea and Stort valleys, *Thalictrum flavum* and plentiful *Potamogeton trichoides*. In the R. Lea (30T88) they found *Callitriche platycarpa*, *Lemna gibba*, *Potamogeton friesii*, *Vallisneria spiralis* occurring farther north than when it was originally reported in the London area (Harris & Lording 1973) and *Zannichellia palustris*. Records of the two *Potamogeton* species mentioned and some others have become extremely scarce, both because of a general decline in the purity of water in our rivers and lakes and because many amateur botanists are unwilling to attempt to put names to sterile scraps of water-weed. On a subsequent visit Mr Wurzell found that *P. trichoides* was in fact extremely abundant and fruiting, fringing several lakes in the same general area, which also furnished sterile *Hottonia palustris*, *Myriophyllum verticillatum*, *Juncus subnodulosus*, *Galium uliginosum* and *Catabrosa aquatica*. Further down the Lea valley Mr Wurzell confirmed that *Oenanthe fluviatilis* is still abundant in one stretch of water near Cheshunt Station (30T62); there is a dot on a map which corresponds to this sadly isolated locality in the flora of the county (Dony 1957) but no other published evidence indicating who knows where it is to be found.

On the other side of the county Miss J. Colthup and Mrs M. V. Marsden found about fifteen plants of *Saxifraga granulata* on Croxley Moor (09T64). This is a well botanised locality and it is extraordinary that a plant so conspicuous in flower had been overlooked there before.

V.C. 21, Middlesex

The most surprising botanical record from vice-county 21 in 1980 is P. J. Edwards's *Carex divisa* on Ealing Golf Course (18T40). In Britain this sedge is almost entirely confined to the neighbourhood of salt water, and its last Middlesex record about a hundred years ago was from near the tidal Thames in the Isle of Dogs (Kent 1975: 559). However the Ealing plant is of a more slender form with a more southerly range on the continent, which does not show the same habitat preference as typical *C. divisa*. This form, which has been considered a separate species *C. chaetophylla* Steudel, used to grow in Richmond Park but has not been seen there for a few decades. On the same golf course Mr Edwards also found *Hypericum humifusum*.

The year's most abundant contributions to knowlege of Middlesex botany have been made by Mrs M. V. Marsden. She searched about 50 lakes and ponds for Charophyta, successfully in about a dozen cases, more than might have been expected, and has also begun investigating a part of the county's Bryophyta with interesting results. These are outside the scope of this paper which begins with Pteridophyta: Mrs Marsden has made the first county records of *Dryopteris borreri*, from Old Park Wood, Harefield (09T40), Grimsdyke (19T42) and near Marsh Lane, Stanmore (19T60). She also found *Polystichum setiferum* in the grounds of Harefield Hospital (09T40) and Bentley Priory Nature Reserve (19T42), and *D. carthusiana* in Old Park Wood. Above Springwell chalk pit (09T42) she found a good assortment of flowering plants, including *Centranthus ruber, Erigeron acer*, a form of *Geranium dissectum* with dark bluish-red petals, *Papaver argemone, Scleranthus annuus, Sisymbrium loeselii, Trifolium arvense* in masses, and late in the season an extraordinary monstrous *Chamaenerion angustifolium* in which the seeds were replaced by miniature plants bursting the sides of the unripe capsules. At lower altitude in the Colne valley she found *Scirpus setaceus* by one of the newer gravel pits (08T48); the meeting she led for us on 19 July unexpectedly turned up *Aponogeton distachyus* naturalised near the outflow from another such pit, near Denham Lock (08T46). On the canal bank between Horsendon Lane and Alperton (18T64) she found *Senecio* × *albescens*, a remarkable place for the hybrid between the cultivated *S. cineraria* (which was nowhere near to be seen) and the common wild ragwort *S. jacobaea*. On waste ground at Rayners Lane, the site of a former sewage farm (18T26), she found the alien *Cyperus eragrostis* Lam., and a fruiting plant of *Cotoneaster frigidus*. Her *Ambrosia artemisiifolia* came from Springwell Lane (09T42). With J. M. Mullin she visited a rubbish tip near West Drayton (07T68); *Hordeum leporinum* Link was among the few aliens they found, and marginal *Chamaemelum nobile* in some quantity looked reasonably wild. Finally, she has tackled that difficult group, the dandelions, finding 40 different ones in Middlesex, some of them too recently recognised as British to be in the work by Richards (1972) who identified her plants.

Mrs Marsden has also communicated to me discoveries made by Miss D. Thompson, which include a plant of *Lepidium latifolium* on waste ground at Harrow Weald (19T40) and a new locality for *Sanguisorba officinalis* at the back of a cemetery in the same general area. The *Lepidium* was also passed on by J. R. Phillips who found the weird alien aroid *Dracunculus vulgaris* Schott as an unexpected weed in a Harrow (18T48) garden.

Another plant new to Middlesex is *Equisetum* × *litorale*, the vigorous hybrid of

E. arvense and *E. fluviatile*, which I collected during our meeting of 17 August by the railway line running alongside Staines Moor (07T22), across the single track from a well-known patch of *Falcaria vulgaris* which was what we had gone to see. The Moor has as good a native flora as any locality in Middlesex. We saw both *Polygonum minus* and *P. mite*, *Ceratophyllum demersum* with fruit (which do not match the published descriptions), *Veronica scutellata* which has become very rare in the London area, unusual quantities of *Triglochin palustris* and many other local species, mostly of wet places. An earlier visit to Staines Moor by the Surrey Flora Committee added *Juncus compressus* and *Sieglingia decumbens* to Mrs Wenham's already impressive list from here.

I can also offer the first published Middlesex record of an alien hawkweed, *Hieracium scotostictum*, which was confirmed for me by C. West. It had previously been collected in the county by a Mrs Browning, near the river at Fulham in 1961, and her specimen, determined by P. D. Sell and Dr West, explains its dot at 51/27 in the 'Critical Supplement' (Perring 1968: 106). My attention was drawn to the 1980 plant by J. M. Montgomery who found it and another hawkweed, perhaps *H. trichocaulon* (it did not stay in good condition long enough to get to a state in which it could be named) in the course of his study of the flora of the postal district EC2 (38T40 mostly). Other excellent discoveries are small plants of *Asplenium adiantum-nigrum* and *A. ruta-muraria* in a very old wall, *Oxalis acetosella* in some rose beds, *Plantago coronopus*, and an abundance of *Solanum nigrum* subsp. *schultesii* (Opiz) Wessely, confirmed by A. C. Leslie. Dr Leslie himself found one plant of the last mentioned at Holdbrook (39T68) and even better, *Torilis nodosa* and hundreds of *Triglochin palustris* further south in the Lea Valley (39T66).

Our meeting of 16 July confirmed the presence of several well known rare established aliens along the Thames bank between Barnes Bridge and Chiswick Bridge, but had not expected a mulberry bush *Morus nigra* L., with ripening fruit, growing out of the stone-work of the river wall just east of the latter bridge (27T06). At the foot of the railway embankment east of Duke's Meadow *Geranium rotundifolium* was where it had been abundant when last reported 20 years ago. The meeting was led by Mr Mullin who on a different occasion found a plant of *Crambe cordifolia* Steven, a spectacular garden subject, on waste ground near the River Brent at Hanwell (17T48).

D. Bevan sent many interesting records from the neighbourhood of East Finchley. *Calceolaria chelidonoides* H. B. & K. as a garden weed is quite as well established as it was in any of the localities mentioned by Lousley (1964); other garden weeds were *Myosoton aquaticum* and *Stachys arvensis*. On waste land near the North Circular Road Mr Bevan found *Potentilla recta*, *Artemisia dracunculus* L., *Lychnis coronaria* (L.) Desr., *Anemone* x *hybrida* Paxton, *Acanthus spinosus* and *Linum usitatissimum* among more common garden escapes and weeds of such places.

New plants from Buckingham Palace (27T88) reported by D. McClintock include *Pteris cretica* L., on a vertical wall where it would be impossible to plant it. This alien fern is increasing in a basement area in Dean Street, W1 (28T80) where it was first noted by Mrs J. McLean in 1968. Mrs McLean found a number of plants unexpected in central London in 1980, most notably *Symphytum tuberosum* in Russell Street, WC2 (38T00) and seven plants of *Dipsacus fullonum* in a car-park behind the Phoenix Theatre (38T00). These were kindly passed on by D. H. Kent, as was P. J. Cribb's *Lythrum junceum* Banks & Sol., as a garden weed at Staines (07T40); details of Dr Cribb's discovery of *Lembotropis* (*Cytisus*) *nigricans* (L.) Griseb. naturalised at Feltham (17T22) have been published elsewhere (Lewis 1980). Mr Kent's own finds include *Geranium lucidum* abundant in a West Ealing garden (17T68), a clump of *Cortaderia selloana* in

rough grass by the railway between Kew Bridge and Brentford (17T88), a few plants of *Bromus inermis* on the Highway, E1 (38T40) and *B. carinatus* spreading rapidly about Gunnersbury and Chiswick (27T26, T28). A specimen of the latter was sent to me by Mrs L. M. P. Small from a garden in Greenford (18T42). Mrs Small also reported unsown plants of salsify *Tragopogon porrifolius* from two gardens in Ealing (18T62). Several more were found in allotments at Enfield (39T26) by Miss M. E. Kennedy.

Mrs Norman found *Petasites japonicus* in Kensington Gardens (28T60), *Festuca gigantea, Humulus lupulus, Sison amomum* and other plants in Holland Park (27T48) and *Chaenorrhinum minus, Mycelis muralis, Verbascum blattaria* and *V. phlomoides* in a neglected bit of garden in Regents Park (28T82?). The last two, though likely to be derived from cultivated plants, appeared to be spreading. Dr G. S. Joyce saw *Angelica archangelica* in full flower under Waterloo Bridge, and also on the jetty where 'Discovery' used to be anchored. Mr Radcliffe reports plentiful *Geranium rotundifolium* by a car-park in the middle of Staines (07T20).

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Mammal Recording in the London Area

by J. COTTON*

The Atlas Project

In 1966 John Burton (*Lond. Nat.* **45** : 35 – 42) published distribution maps for selected species of mammals in the Society's area. Since then records sent in by members have been accumulating, and it would be desirable to publish more up-to-date maps, as suggested in Cotton, (*Lond. Nat.* **58** : 71 (1979)). An appeal for records was circulated to members in February 1981, which resulted in twice as many records being submitted — as many were sent in after the appeal as were sent in before it. As a result the geographical spread of records is tabulated and discussed below, in contrast to the format used in previous years. If enough records are received over the next two years, it may be possible to publish a provisional Atlas on the lines of that produced by the I.T.E. Biological Records Centre at Monk's Wood.

However, even more records than were submitted this year will be needed for an Atlas to be worthwhile. For common and easily recognised species, such as fox, hedgehog and grey squirrel, appeals through schools, the local press, and local radio (as used by Colin Plant, *Lond. Nat.* **58** : 27 – 37 (1979)) can be used. For some animals even reasonably complete coverage will not be possible — only casual sightings will be available (e.g. stoat, weasel, otter). For some an organised campaign may be successful: using Longworth traps for small mammals, and bat recorders (J. H. D. Hooper, *Lond. Nat.* **60** : 47 – 63, 1981), or possibly a specialist group netting bats, such as the group who found *Pipistrellus nathusii* in the Society's area.

It was remarked in Cotton (1979 above) that records can only be used for distribution maps if grid references are given, or at least the name of the road, park, etc., if this can be localised to one 1 km grid square. At present records are being collected on a 1 km square basis, but tetrads (2 km squares) may be used for publication. The table below is intended to represent the number of usable records submitted. Those submitted without grid references or sufficiently accurate locations are not included, and so far as possible duplicate records for the same square are omitted. The Society's area contains over 3,000 1 km grid squares, which indicates the amount of work still needed, even for species like the grey squirrel.

Mammal Records submitted for 1980

The records received for 1980 are tabulated below. No marine mammals were reported during the year (cf. Cotton 1979 above, and 1980 *Lond. Nat.* **59** : 84 – 86). Bats are excluded because of the problem of identification.

The records submitted give some indication of the distribution of mammals in London — the species list for Inner London given here is reasonably complete — but gives a more accurate picture of the distribution of members who submit records. No records at all were received from Buckinghamshire — evidently they are sent to the B.B.O.N.T. recorder rather than the L.N.H.S. The same probably occurs in other county areas, so the Atlas would require the cooperation of the surrounding county trusts. While Hertfordshire produced few records, it provided half those for the water vole, which indicates the importance of a few active and efficient recorders. A substantial number of grey squirrel records were

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sent from the urban parts of Surrey and Middlesex, where members may have little chance to see other species, but this species was neglected in the outer parts of the Society's area where other species are a rival attraction.

The nomenclature and checklist numbers follow G. B. Corbet's *The Identification of British Mammals*, Ed. 2 (1969). The columns represent: E Essex, H Herts., I Inner London, K Kent, M Middlesex, S Surrey.

Species:		*E*	*H*	*I*	*K*	*M*	*S*	*Total*
1.	HEDGEHOG *Erinaceus europaeus*	3	3	4	9	24	15	58
2.	MOLE *Talpa europaea*	6	4	—	5	6	3	24
3.	COMMON SHREW *Sorex araneus*	7	1	—	2	—	4	14
4.	PYGMY SHREW *Sorex minutus*	2	—	—	2	—	2	6
5.	WATER-SHREW *Neomys fodiens*	—	—	—	—	—	1	1
24.	FOX *Vulpes vulpes*	15	2	3	10	8	17	55
27.	STOAT *Mustela erminea*	4	1	—	—	—	—	5
28.	WEASEL *Mustela nivalis*	7	2	—	1	—	2	12
30.	AMERICAN MINK *Mustela vison*	—	1	—	1	—	—	2
31.	BADGER *Meles meles*	—	—	—	3	—	5	8
44.	FALLOW DEAR *Dama dama*	—	—	—	—	—	1	1
45.	ROE-DEER *Capreolus capreolus*	—	—	—	1	—	3	4
47.	CHINESE MUNTJAC *Muntiacus reevesi*	—	—	—	—	—	1	1
53.	BROWN HARE *Lepus capensis*	3	1	—	—	—	2	6
55.	RABBIT *Oryctolagus cuniculus*	13	9	—	5	3	7	37
57.	GREY SQUIRREL *Sciurus carolinensis*	15	9	9	14	27	42	116
59.	DORMOUSE *Muscardinus avellanarius*	1	—	—	—	—	1	2
61.	HARVEST-MOUSE *Micromys minutus*	1	—	—	—	—	—	1
62/3.	WOOD-MOUSE *Apodemus sylvaticus* and *Apodemus* sp.	4	1	1	5	2	9	22
63.	YELLOW-NECKED MOUSE *Apodemus flavicollis*	—	—	—	1	—	1	2
64.	HOUSE-MOUSE *Mus musculus*	9	—	1	—	3	2	15
66.	BROWN RAT *Rattus norvegicus*	5	—	3	1	6	5	20
67.	BANK-VOLE *Clethrionomys glareolus*	2	—	—	2	—	5	9
68.	WATER-VOLE *Arvicola terrestris*	7	10	—	1	2	—	20
69.	FIELD-VOLE *Microtus agrestis*	10	—	—	1	2	5	18

Amphibia and Reptilia in the London Area 1979 and 1980

by PETER W. KING*

AMPHIBIA

GREAT CRESTED NEWT *Triturus cristatus*

KENT. Blackheath Wanderers golf course. Eltham Warren golf course. Eltham Park, in north part near a fenced-off pond. Army Training Grounds, Rotunda Road, Woolwich, S.E.18. War Department land behind 76, Birdbrook Road, London, S.E.3. Joyden's Wood. Darrick Wood, Orpington.

SMOOTH NEWT *Triturus vulgaris*

HERTS. Croxley Green, two females in garden pond each year (TL084956).

KENT. Blackheath Wanderers golf course. Eltham Warren golf course. Eltham Park, in north part near a fenced-off pond. Pleasance Park, Well Hall, Eltham. Army Training Grounds, Rotunda Road, Woolwich, S.E.18. War Department land behind 76, Birdbrook Road, London, S.E.3. Joyden's Wood. Darrick Wood, Orpington. Farningham Wood, south side near the motorway.

MIDDX. Mud Chute, Isle of Dogs, London, E.14. Brook Road, Dollis Hill, London, N.W.2, scarce resident spawning in garden ponds and one surviving former farm pond on allotments. Finchley, four found in July 1980 while clearing an overgrown, badly drained garden (TQ253899). Also reported from garden ponds around the Finchley and Barnet areas generally, but no other specific localities.

PALMATE NEWT *Triturus helveticus*

KENT. Blackheath Wanderers golf course. War Department land behind 76, Birdbrook Road, London, S.E.3. Joyden's Wood.

NEWT *Triturus* sp.

MIDDX. Front doorstep of house adjacent to Uxbridge Common pond, one found in Spring 1980.

COMMON TOAD *Bufo bufo*

ESSEX. 23, Lytton Road, Leytonstone, London, E.11. Several resident in a small back garden with no pond. Road outside Chigwell Row Church, Hainault (TQ466933). Loughton, a dead squashed carcass on 19 May 1979 (TQ4296). Wanstead Sewage Works (TQ4287).

HERTS. Cassiobury Park, many breed and tadpoles often seen in both years (TL089964).

INNER LONDON. William Curtis Ecological Park, Vine Lane, Southwark, London, S.E.1. Introduced here and flourishing.

KENT. Blackheath Wanderers golf course. Eltham Warren golf course. Eltham Park. Army Training Grounds, Rotunda Road, Woolwich, London, S.E.18. War Department land behind 76, Birdbrook Road, London, S.E.3. Darrick Wood, Orpington.

MIDDX. Hampstead Heath, numerous. Garden near Highgate Village, up to 15 present (TQ285876). Garden in Hampstead garden suburb, only one (TQ254881). Darlands Lake nature reserve (TQ244934). Osterley Park, spawns in pond annually. 54, Whitehall Park Road, Chiswick, London, W.4, one found hibernating in the over-

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grown garden. 6, Netheravon Road, London, W.4, spawned 1980. 18, Gravel Road, Twickenham: introduced 1972 (TQ152731). 76, Hazelwood Road, Bush Hill Park, Enfield, abundant resident (TQ341953).

SURREY. 72, Wolsey Road, East Molesey, present in garden summer and autumn 1980. Mitcham Common, in rough grassland and scrub north of the large pond, seen frequently. Rough grassland just south of Mitcham Junction station, one seen July 1979. Footpath through Croydon Cemetary, just east of Mitcham Common, several seen moving across on a wet night in March 1980. Croham Hurst, seen frequently. 52, Friends Road, Central Croydon, resident in garden. Ashtead Common, seen frequently. Bookham Common, seen frequently, distributed throughout the common.

COMMON FROG *Rana temporaria*

ESSEX. Wanstead Sewage Works (TQ4287).

HERTS. Cassiobury Park, present in small numbers, spawn in disused watercress bed in March both years (TL089964). Croxley Green, up to ten around the garden pond, May to July 1980 (TL084956).

INNER LONDON. William Curtis Ecological Park, Vine Lane, Southwark, London, S.E.1. Introduced. Contrary to fears expressed in my last report it has survived here.

KENT. 206, Green Lane, Eltham, London, S.E.9, in garden both years (TQ435729). Green Lane, Eltham, London, S.E.9, one seen crossing pavement on 6 March 1980, at (TQ435733). Blackheath Wanderers golf course. Eltham Warren golf course. Eltham Park, near and in fenced-off pond. Pleasance Park, Well Hall, Eltham. Army Training Grounds, Rotunda Road, Woolwich, London, S.E.18. War Department land behind 76, Birdbrook Road, London, S.E.3. Darrick Wood, Orpington. Farningham Wood, south side near the motorway.

MIDDX. Hampstead Heath, infrequent, spawn only seen in one pond in 1980. Allotment in railway cutting on the south side of Hampstead Heath, one seen. Garden in Highgate Village, two seen in 1980 (TQ285876). 85, Brook Road, Dollis Hill, London, N.W.2, breeds annually. Alexandra Park, Muswell Hill, London, found in two areas. Darlands Lake nature reserve, common, spawns every year (TQ244934). 83, Wentworth Avenue, Finchley, London, N.3, spawns every year in garden pond and also in at least two other ponds nearby. 112, Corringway, Ealing, London, W.5, one by side of front drive in autumn 1979. 6, Netheravon Road, London, W.4, spawned in 1980. Uxbridge Common pond, many spawned in March 1980, and two adults were seen in a garden adjacent to the pond in June 1980. 76, Hazelwood Road, Bush Hill Park, Enfield, abundant resident (TQ341953).

SURREY. 15a, Dunsford Rise, Coulsdon, one seen regularly in summer 1980. Streatham Common, the Rookery, spawns in ornamental garden. Telford Avenue Tennis Club, Killieser Avenue, London, S.W.2, abundant, spawning March 1980. Much spawn was destroyed. Harborough Road, Streatham, London, S.W.16, one seen in garden 5 and 6 September 1980. U.D. Site, waste ground, Valley Road, Streatham, London, S.W.16, one seen August 1980. Tooting Bec Common, spawned 1980. Belair Park, Gallery Road, Dulwich, London, S.E.21, spawn and tadpoles seen in the dammed branch of the River Effra in the park. Mitcham Common, near large pond, frequently seen. Bookham Common, widespread, spawns in most ponds and spawn also found in temporarily flooded marshy ground on Western Plain near Bookham Stream in March 1980. Single adults seen occasionally.

Introduced amphibians

TREE FROG *Hyla arborea*

KENT. War Department land behind 76, Birdbrook Road, London, S.E.3. Introduced deliberately by Mr J. Snell.

AMERICAN BULLFROG *Rana catesbeiana*

KENT. Plumstead, the Dell Pond. Origin unknown.

MARSH FROG *Rana ridibunda*

MIDDX. River Crane, in flood relief channel in summer (TQ151733) and at (TQ148732) where it was seen in August 1980 for the first time. There are also reports of calling frogs from further upstream. The origin of this population is not known.

REPTILIA

GRASS SNAKE *Natrix natrix*

ESSEX. Wanstead Sewage Works (TQ4287), a very large breeding colony. St Mary's Nature Reserve, East Ham. Northern outfall sewer bank in East Ham, Plaistow and Stratford. Avenue Road, Forest Gate, on railway embankment.

INNER LONDON. Waste ground off Old Bethnal Green Road, Bethnal Green, London, E.2. Might be an escaped pet.

MIDDX. Darlands Lake nature reserve, seen in summer both years (TQ244934).

SURREY. Ashtead Common, seen on six separate occasions in July 1980, all sightings being from an area of marshy ground in the southwest corner of the common. Bookham Common; sloughed skin found on 19 July 1979 near the Isle of Wight, one seen in Station copse September 1980, one seen in Bayfield Plain September 1980.

ADDER *Vipera berus*

SURREY. Woldingham, Long Hill, one seen sunning itself on this unmade road on 4 March 1979. Two found coiled together on a grassy slope above this road on 9 July 1979.

COMMON LIZARD *Lacerta vivipara*

ESSEX. St Mary's Nature Reserve, East Ham.

KENT. Honeybourne Way, Petts Wood, one found on garden path after dark, 7 October 1979. Joyden's Wood. Farningham Wood.

SURREY. Kent's Field, Woodmansterne, one caught by cat on 5 May and 11 May 1980, and on both occasions released alive. Ashtead Common, seen on several occasions in summer of both years in the areas of rising ground in the centre and at the west edge of the common, near the edge of the bracken covered area. Bookham Common, frequently seen basking in the sun on decaying elm logs in Station copse area. Adults seen both years until mid October. Small black young also seen basking here in September and early October in both years. Rough grassland just south of Mitcham Junction station, one seen sunning itself on 29 October 1980.

SLOW WORM *Anguis fragilis*

ESSEX. Wanstead Sewage Works (TQ4287). St Mary's Nature Reserve, East Ham. Northern outfall sewer bank, Plaistow. Wanstead Park. Avenue Road, Forest Gate, on railway embankment.

HERTS. West Herts golf course, one seen, 1 August 1979.

KENT. War Department land, behind 76, Birdbrook Road, London, S.E.3. Joyden's Wood. Farningham Wood.

MIDDX. 83, Wentworth Avenue, Finchley, London, N.3, in back garden, summer both years. Railway embankment, Finchley (TQ253912). Railway embankment, Totteridge (TQ259947).

SURREY. 15a, Dunsfold Rise, Coulsdon, one in compost heap, early autumn 1980. Welcomes Road, Kenley, in the lower part at about 300 ft altitude; three found dead on

the road, July 1979; one dead August 1979; one dead September 1979. 89, Riddlesdown Road, Purley, one young in garden, 4 October 1980.

Introduced reptiles

SAND LIZARD *Lacerta agilis*

KENT. War Department land behind 76, Birdbrook Road, London, S.E.3. Introduced inadvertently by Mr J. Snell, who mistook them for wall lizards.

WALL LIZARD *Podarcis muralis*

KENT. War Department land behind 76, Birdbrook Road, London, S.E.3. Introduced deliberately by Mr J. Snell.

I wish to thank all those members who have submitted records in the past two years. In view of the desirability of including distribution maps of the amphibians and reptiles as a sequal to the proposed atlas of mammals in the London area, it is hoped that even more records will be returned for 1981.

Book Review

A Guide to Kemsing Down Nature Reserve. Compiled under the direction of the Environment Committee by Brian Doe (and others). Kemsing Parish Council. £0.50.

The area described in these 50 octavo pages is about 36 acres, north of the village of Kemsing in Kent, just 20 miles from St Paul's Cathedral. It is part of a chalk slope acquired by the parish council in 1976 to prevent an extension of the threat represented by a development company, which had purchased ground below with the intention of breaking it up into 'leisure plots'. With help from the Kent Trust for Nature Conservation, the council is managing this part of its acquisition as an open-access nature reserve.

It is hard to see how the guide could be more effectively arranged. The greater part of it is set out as a walk around the reserve, following an itinerary mapped on the back cover, stopping at numbered points to consider the plant and animal life, assorted elements of which are illustrated by delightful line drawings. A folding page stuck into the middle sketches the considerable view from the hill-top. At the end are checklists of trees and shrubs, of other plants (these two are in alphabetical order of English names, rather oddly, and lack grasses and sedges), butterflies and vertebrates.

Kemsing deserves to be congratulated for its initiative. Its reserve should still have many of its natural attractions half a century from now, when other Sites have long since lost the Special Scientific Interest for which they were scheduled, for lack of appropriate management. Perhaps by then too the parish will have been able to repay its loan and close down its appeal fund; this target would be reached a little sooner if this guide had been sold at twice the price, nearer its true value.

R. M. BURTON

A Review of the Lepidoptera of the London Area, 1978 to 1980

by C. W. PLANT*

Introduction

Since the sad loss of Baron de Worms in October 1979, there was no recorder for London's Lepidoptera until just over a year later, when I was appointed to this position. This has inevitably resulted in there occurring a slight breakdown in the 'system'; those persons with records not knowing where to send them, and perhaps others who may not have kept their records thinking that there would be no further need for them. The situation has been worsened by the fact that the LNHS Lepidoptera records held by the Baron at the time of his death have apparently, since that date, gone missing. Consequently, this review of London's Lepidoptera, for the three years since the Baron's last review, is formed entirely from records received by me between September 1980 and the end of January 1981, and it will be seen that whilst there has been a moderate contribution to our knowledge of the distribution of London's butterflies, there is a distinct shortage of moth records. Those lists of moths which I have received comprise, largely at any rate, the commoner species such as the large yellow underwing *Noctua pronuba* and the cabbage moth *Mamestra brassicae,* and others which could be reasonably expected to show up throughout London wherever the larval food plants are available. It seems rather pointless to repeat these lists here; rather I have made a selection of some of the more interesting or noteworthy species for publication. The butterfly records are published in full, and the absence of certain uncommon but nevertheless regularly reported species is suggestive that many more records have yet to reach me. It is my intention to include in my reviews a section on what have been popularly referred to as 'microlepidoptera'. The success of this venture will depend greatly upon observers sending in records to me at the end of each year, and I will end this introduction therefore with a request to readers to send me your Lepidoptera records, not only for the next two years, but also for the three years past. Although such notes will be too late for inclusion in *The London Naturalist,* they will be of immense value if properly collated and filed.

The scientific names of the butterflies and moths, and the order in which the species are presented within each of the three following sections, are to be found in *A Recorders Log Book or Label List of British Butterflies and Moths* by J. D. Bradley and D. S. Fletcher (Curwen Press, 1979). It would be preferred if contributors adopted the same names and sequence when submitting records for publication in these reviews.

Microlepidoptera

To deal with inner London first, from the William Curtis Ecological Park, in the shadow of Tower Bridge, come records of three fairly abundant species, namely *Evergestis extimalis, Ostrinia nubilalis* and *Endotricha flammealis.* All three are pyralids, perhaps the most well known and easily recognised of the micro moths, and are probably present in several other inner London areas. From the vicinity of Holland Park comes a record of the skin moth *Monopis rusticella,* the larvae of which will readily feed on dog faeces, a fact which may account for its presence in a number of other inner London areas. From the same area are records of *Plutella xylostella* and *Mompha subbistrigella,* in the same light trap as

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three fairly prevalent tortricoids: *Cacoecimorpha pronubana, Acleris variegana* and *Olethreutes lacunana.*

The two vice-counties of Essex which protrude into the LNHS area are now extremely well recorded. A paper on the Essex Microlepidoptera has been prepared by Lt. Col. A. M. Emmet, and appears in the 1980 volume of *The Essex Naturalist.* It would be rather pointless, and extremely time consuming to repeat the relevant parts of Col. Emmet's paper here, but one species which does deserve mention is the mung moth *Maruca testulalis* Geyer, a specimen of which was taken at light in Wanstead Park in August 1979. This is an 'accidental' species in Britain, normally only being found as larvae in imported beans. This individual was apparently the first imago to be taken in the wild in Britain, but almost certainly originated from imported produce on sale locally.

Larger Moths

For reasons already stated, the records are few, and there is a definite bias towards V.C. 18 (South Essex), where I run my own trap and where my own local contacts have passed their records to me for inclusion here.

A few records have been received from Hampstead Heath (V.C. 21: Middlesex), amongst which are the narrow-bordered five-spot burnet *Zygaena lonicerae,* the chimney sweeper *Odezia atrata* and the burnet companion *Euclidia glyphica.* From a light trap operated near to Holland Park (inner London), is a record of the pale brindled beauty *Apocheima pilosaria,* but the only other inner London records come from the William Curtis Ecological Park, where fifty-eight species came to light during 1980. Amongst these were the six-spot burnet *Z. filipendulae* and the nutmeg *Dicestra trifolii.*

In Essex, leopard and goat moths *Zeuzera pyrina* and *Cossus cossus* are reported from Walthamstow, while the six-spot burnet was present at Ongar Park Woods. The same Walthamstow site also produced a currant clearwing *Synanthedon tipuliformis,* while other clearwings from Essex were the yellow-legged *S. vespiformis,* on Sunshine Plain, Epping Forest, and the red belted *S. myopaeformis* at Romford.

Few hawk moths have been reported: the larvae of the privet hawk *Sphinx ligustri* were found at Forest Gate and Ongar Park Woods, whilst the lime hawk *Mimas tiliae* was spotted at Walthamstow, Leytonstone, East Ham, and Hainault. The poplar hawk *Laothoe populi* was only reported from Leytonstone in Essex, but was also present in Kent, at Dartford Station. The familiar larvae of the large elephant hawk moth were seen at Stratford, East Ham, Leytonstone and Wanstead Park, as well as from the Mud Shute area of the Isle of Dogs (Middlesex).

The cocoons of the puss moth *Cerura vinula* were found on the trunk of a large willow at Forest Gate, and the larvae were reported on willow trees at Ilford and Walthamstow. The poplar kitten *Furcula bifida* was also recorded from these latter two sites. The troublesome brown tail *Euproctis chrysorrhoea* seems to have reached a considerably lower population level in 1980 than in 1978, when it was causing much damage to the vegetation in the eastern portion of the LNHS area. It is still present in most of that part of the vice-county of South Essex which is in the London area, but information from the other vice-counties is sparse. The very similar yellow-tail moth *E. similis* has only been reported from a single locality — at Hainault Forest.

To complete the review of the larger moths, a lunar yellow underwing *Noctua orbona* was taken at my trap in Plaistow during 1978. This moth is very similar to

the much more common lesser yellow underwing *N. comes* which appeared fairly widespread in the London area during 1980.

Butterflies

The few records received herald from many different parts of the London area and amount to a humble 34 species. The majority of these records relate to 1980 only, and there is a consequent lack of information for the two previous years. Inner London records come only from a few places, notably the Surrey Docks and the William Curtis Ecological Park, and it was from the former location that an imago of the long-tailed blue *Lampides boeticus* was reported during August 1980. The presence of eleven species at the William Curtis Ecological Park is of particular interest, since it is only a very few years since this ecological oasis was created from a deserted lorry park. It is interesting to notice just how soon the butterflies will move in to a suitable area, and it is worthy of note that the larval food plants of all eleven species are present on the site.

Turning attention to the systemmatic list, small skippers *Thymelicus sylvestris* have been widely reported from all of the vice-counties except Bucks., with thriving colonies in particular at Ashtead Common, Hampstead Heath, the Lea Valley and the Roding Valley. The very similar Essex skipper *T. Lineola* is by no means confined to the county where it was first recognised in Britain; there were notable colonies at Barn Elms in 1978, Staines Reservoir in 1978 and 1979, and at the Lonsdale Road Reservoir in all three years, with 140 plus on 24 July 1979. At Wanstead Sewage Works *lineola* outnumbered *sylvestris* by a factor of two during 1980. The large skipper *Ochlodes venata* seems to be a much less common beast however, with scattered records of individuals from the Wanstead area, Ongar, Claybury Hospital Woods and St Mary's Nature Reserve, East Ham — all Essex localities. The only non-Essex records are of one imago at Barn Elms Reservoir on 18 August 1978, and a few at Cheshunt Gravel Pit during 1980. There are two records of the dingy skipper *Erynnis tages;* from Shirley Hills, Croydon, and from Ruislip Common, both during 1980, and to complete the Hesperiidae there was a single grizzled skipper *Pyrgus malvae* at Ham River Lands in Surrey, on 16 June 1979.

Another species for which there is but a single record, is the clouded yellow *Colias croceus;* a single adult was seen at Ongar, Essex, during 1980. The brimstone *Gonepteryx rhamni,* on the other hand, seems to have been rather more numerous, being seen at various localities during 1980 from which it had apparently been absent for many years. Brimstones 'in profusion' were reported from Shirley Hills, Farthing Down, and Ashtead Common, while lesser quantities were present at Farnborough, Hayes, Epping, Beddington Sewage Works and Woodford. The 'three whites' remain numerous throughout the London area, although the large white *Pieris brassicae* is present in much lower numbers than the small white *P. rapae* and the green veined white *P. napi.* The only inner London records are from the William Curtis Ecological Park, where all three species were present during 1980. A count of one thousand plus *rapae* was obtained at Petts Wood, Kent, on 29 July 1978. The orange tip *Anthocharis cardamines* was reported from a wide range of localities from all of the vice-counties in all three years, although there were no inner London records. Ruislip common held this species in profusion during 1980. Moving on to the Lycaenidae, the green hairstreak *Callophrys rubi* was seen only once: at Bletchworth, Surrey, during 1979, whilst the purple hairstreak *Quercusia quercus* was reported from Ashtead Common in 1978, and from Ruislip Common ('in profusion'), Hainault Forest, and Epping Forest during 1980. Small coppers *Lycaena phlaeas* were recorded at several suitable localities in Kent, Surrey, Herts., Middx., and Essex. One was watched by the busy Barking Road at Plaistow during 1978, and an inner London record is provided by a few

individuals at the William Curtis Ecological Park during 1980. The Surrey Docks, also inner London, provided the only long-tailed blue *Lampides boeticus*, on 26 August 1980, in what appears to have been a fairly good year for British records of this species. There are two records of the brown argus *Aricia agestis*, a fairly uncommon lycaenid in the London area. Both were during 1979, with one at Chipstead on 11 August, and one at Balaam Street, Plaistow, during the same month. The common blue *Polyommatus icarus* is as plentiful as its name suggests it might be, being widely reported from each of the vice-counties in the LNHS area. There were however, no inner London records, and 1980 numbers appear to be lower than in the two preceding years. A small colony of the chalkhill blue *Lysandra coridon* was found on a chalk downland site in west Kent, adjacent to the Surrey border, on 9 August 1980, and a single adonis blue *L. bellargus* occurred at the same site during 1978. This latter species is apparently rather local in its distribution in west Kent. The holly blue *Celastrina argiolus* was a rather more common sight, with records coming from Barnes, Kew Gardens, Hampstead Heath, West Wickham, Ongar and Wanstead.

Only a single white admiral *Ladoga camilla* has been reported: at Ashtead Common during an LNHS outing there on 5 August 1978, whilst the red admiral *Vanessa atlanta* has as usual been seen in a variety of localities from Kew Gardens in the west to Thamesmead in the east, with inner London records from the William Curtis Ecological Park. 1980 was an exceptionally good year for the painted lady *Cynthia cardui* with a good number of sightings from June to August. Six were seen together at Romford, and a very worn specimen was watched feeding on ground elder *Aegopodium podagraria* at St Mary's Nature Reserve, East Ham. An unexpected visitor to the area was a large tortoiseshell *Nymphalis polychloros* at Hainault during 1978: much more common is its smaller cousin the small tortoiseshell *Aglais urticae* which is probably the most common and widely distributed butterfly in London. Both the peacock *Inachis io* and the comma *Polygonia c-album* were recorded from all areas other than inner London during each of the three years, but the dark green fritillary *Argynnis aglaja* was reported only twice — from Farthing Down on 9 August 1980, and at the same chalk downland site that produced the chalkhill and adonis blues, where it has been present at least since 1977.

The Satyridae are well represented in the London area. Speckled woods *Pararge aegeria* were spotted at Ruislip Common, Ashtead Common, Farthing Down, West Wickham and Epping Forest during 1980, although they were more widely reported during the two previous years. There is an inner London record of the wall brown *Lasiommata megera* at Nine Elms on 23 May 1978, but otherwise there are few sightings of this species — Brentford Dock, Chiswick, Kew Gardens, Potters Bar, West Wickham and Wanstead being the places reported. The gatekeeper *Pyronia tithonus* is abundant in the north east of the LNHS area, where I recorded it from 26 tetrads during 1980, (all in V.C. 19, North Essex). Elsewhere, records relate to south Essex localities and to Potters Bar, Perry Oaks Sewage Farm and Staines Reservoirs, all in 1978. The meadow brown *Maniola jurtina* appears almost as widespread as the small tortoiseshell, and much the same can be said for the small heath *Coenonympha pamphilus*, albeit in much smaller numbers.

Finally, there are two records of the ringlet *Aphantopus hyperantus:* from Petts Wood during 1978, and from Farthing Down in 1980.

Acknowledgments

I am grateful to the following people who sent in their butterfly and moth records relating to the three years under review: H. Baker, R. F. Baker, R. Bowes, P. Ferris, T. Franklin, V. Franklin, M. W. Hanson, R. B. Hastings, M. Hadley, P. J. King, T. Lyle, D. Murdoch,

N. Nash, R. W. Peters, L. C. Plant, S. M. Rayment, R. A. Softly, J. A. Spinks, P. Strangeman, J. Tyler, G. J. White, and the Wren Conservation Group.

I should also like to thank Mr I. G. Robertson, MA., FMA., Curator of the Passmore Edwards Museum for permission to reproduce data stored at the West Essex Biological Records Centre at that Museum.

AN ATLAS OF LONDON'S BUTTERFLIES

Whilst the biennial reviews of London's Lepidoptera are useful, in that they lay on record important observations, as well as, hopefully, presenting the information in a readable manner to specialists and non-specialists alike, there is a physical limit to the amount of scientifically useful information which they can contain. One specific failing of such reviews is that they cannot adequately convey to those who need to know, the precise distribution of a given species within a geographical area. Such data are now traditionally presented as dot distribution maps, combined to form an Atlas. The LNHS has already produced an *Atlas of Breeding Birds of the London Area* (Batsford, 1977) whilst a similar publication on the flora is in preparation.

It is therefore intended to produce such an Atlas of London's Lepidoptera, and, since the majority of species are quite readily identifiable, butterflies will be the subject of the first volume. Such a project is unlikely to succeed without the support of the many dedicated naturalists and interested amateurs living or working in the London area, and consequently this article is an appeal for observations. The way in which the Atlas Project will be organised is set out below:

Objective

To produce a definitive atlas presenting the distribution of all butterflies within the London Area, including migrants.

Geographical Area

A circle of twenty miles (32km) radius, centred upon St Paul's Cathedral, i.e. the LNHS recording area. Maps of the area are available from the organiser upon receipt of a large stamped addressed envelope.

Recording Units

Tetrads: that is 2 x 2 kilometre squares.

Size of Area

856 tetrads, in a total of 44 ten-kilometre squares.

Recording Periods

Pre-1900;
1900 to 1959;
1960 to 1979;
1980 to 1986.

Target Dates

It is hoped that a Provisional Atlas can be produced at the close of 1984, with the final Atlas being ready for publication at the end of 1986.

Project Organiser

Please send all records, which should include dates and grid references as well as any appropriate notes, to Colin W. Plant, Passmore Edwards Museum, Romford Road, Stratford, London, E15 4LZ.

Obituaries

ERIC REGINALD PARRINDER, C.B.E., 1914 – 1980

Though E. R. Parrinder's contributions to ornithological literature were always signed thus he had early in life been dubbed John, and it was by this appropriately strong and uncompromising syllable that he was always known. John was born on 5 March 1914 at New Barnet and died on 20 June 1980, barely a year after he had retired to the house he had built overlooking the marshes at Cley in Norfolk. After a childhood spent in Leigh-on-Sea, where he was educated, he settled in London at the time of his marriage in 1937.

John came to ornithology through his wife, Eileen, who introduced him to wader watching on the Essex marshes. His interest once aroused he began a serious study of birds, joining the London Natural History Society in 1938. A year later he was a member of the records committee of the Ornithological Section. With the disruption of war he was despatched to work as a site surveyor on contracts for the War Office. (An injury to a hand kept him in civilian employment). This work took him often to remote corners of the country where he put his leisure to good use studying the local birds; one such project — a study of stonechats — was published in *British Birds* in 1945.

Throughout the war John took some part in the management of the Society's limited activities, first as joint editor of the *London Bird Report,* then as editor for a year and thereafter as a member of the Records Committee until 1952. Back in London again in 1945 he joined a well-known firm of chartered quantity surveyors where he rose, over the years, to be the senior partner. The Society was now building up its membership and setting out on renewed lines of research and enquiry, and as a member of Council (1945 to 1951) John made a significant contribution to the work of the ornithologists. He possessed a mind that quickly grasped essentials and being clear thinking, articulate and innovative he was an asset to every committee on which he served.

Post-war ornithology offered considerable scope since there were other minds as acute as his involved in the action. As chairman of the Ornithological Section from 1949 to 1951 and as a member of the Research Committee throughout the decade he played a major role in London's ornithology. This was the period when species of special interest to London birdwatchers — black redstarts and great crested grebes among them — were being studied. But it was the little ringed plover, recently established as a breeding species, on which John did much original work and which was to hold a life-long fascination for him. Another interest at this time was migration and hence ringing. One of his earliest attempts to plot visible migration was in October 1948 when a party of London birdwatchers were taken to spend a weekend on forts in the Thames estuary built for London's defence. Here, to the astonishment of the squad manning Fort U7 (long since demolished) three of us spent sleepless hours in light rain logging the passage of a few dozen migrants. On occasions such as this John's determination to extract every possible advantage out if ill-fortune became evident as did his hearty laugh when the funny side presented itself. Migration watching from some new vantage point would find John assembling a team: sometimes from the end of the decrepit pier at St Mary's Bay on the north Kent marshes or further afield at Spurn Point where new birds in the hand and large numbers of passage migrants lent excitement. His experiences on the Humber aroused his enthusiasm for a bird observatory nearer home and when Dungeness was mooted he was quickly at work on the project. From the day in 1952 when the first bird was trapped, until his death he was chairman, first of the Management Committee and later of the Trustees.

In the London Starling Enquiry, 1949 to 1951, John again played a dominant role, along with Stanley Cramp, Barney Richards and the writer. Over 3,000 birds were ringed at the roosts around Trafalgar Square, fly-lines were mapped and censuses carried out at gathering places. While starlings accounted for many an evening after office hours, the time between dawn and the start of the day's work was unoccupied. But not for long! John's plan, again with the writer, was to log visible migration over central London, hence a regular roof-top rendezvous once more in Trafalgar Square. Little, if any, such observation had been made in central London since the turn of the century when D. F. Power, in Brixton, reported on daytime migrants. The work of these busy years was summarised in the chapters John contributed to *The Birds of the London Area since 1900* published in 1957. By the end of the 1950s the claims of his profession forced him to curtail his active ornithology, nevertheless he continued to serve the cause of conservation not only in London but also in Kent, whence he had gone to live, and where he was a founder member of the Kent Ornithological Society. To the British Trust for Ornithology, on whose council he served, he gave valuable help particularly as honorary treasurer for four years. But perhaps the scale of John's dedication to birds an best be gauged by his unbroken service on the council of the Royal Society for the Protection of Birds for twenty-five years.

At the height of his career which had been distinguished by the award, in 1971, of the C.B.E., John's birdwatching was confined largely to the journeys that took him to the farthest ends of the earth — to both polar regions as well as Africa and the Americas — observing, photographing, taping, always amassing knowledge. Being a man of determined aspirations and strong views he was not always easy to get along with but in the field he was adventurous and a stimulating companion. His death robbed him of long anticipated delights, watching birds at a classic site on the doorstep of the house he designed for the purpose. To his widow, Eileen, a fellow member of the Society, who shared his love of birds, and to his son and daughter we extend our sympathy.

LESLIE BAKER

FRANCIS JAMES HOLROYDE, M.C., 1893 – 1980

When Frank Holroyde died on 1 October 1980 we lost one of our staunchest wildlife conservationists. He joined the LNHS in 1944 and was a member of the Nature Conservation Committee from 1962 until 1977. His name appears in the *London Bird Report* as far back as 1943 and he was a regular contributor from then on. He was a founder member of the Kent Trust for Nature Conservation and a member of the K.T.N.C. Conservation Committee.

Frank was not a scientist and claimed only to have an instinct for protecting wildlife, especially in suburban south-east London where he was warden of Ruxley Gravel Pits nature reserve. The K.T.N.C. appointed him as the honorary warden at Ruxley in 1960 and he carried this responsibility until 1978. Anyone who has ever come into contact with Frank will know that he would have gone on protecting the wildlife in the area for ever if it had been possible. It was only for health reasons that he assumed the less physically arduous role of special adviser to the reserve naturalist committee, a role which he fulfilled with vigour until his death.

Because of his authority at the nature reserve Frank enabled many papers to be published, most notably in the *Transactions of the Kent Field Club*. He was an adroit and impressive speaker and charmed many audiences with his talks on nature conservation. All his life he had a deep love and concern for the wellbeing

of the natural world and more than this he was always concerned for the wellbeing of those for whom and with whom he shared his life.

His wife died only a few months before Frank and readers will wish to extend their sympathy to his surviving sister and two sons. We paid our last respects to him at a memorial service at St John the Evangelist, Bromley, Kent, on 10 October 1980.

A. J. WATSON

Statement of Affairs

	1979			
		Premises and Equipment Fund (incorporating the Hindson and Castell Bequests)		
81,595		**Balance at 1 November 1979**		85,348
	34	*Add:* Investment deposit interest	161	
	338	National Savings Bank interest	838	
	4,185	Investment income received	4,646	
	1,785	Income tax recovered	1,884	
	(1,513)	Profits less losses on sales of investments	(867)	
	4,829		6,662	
	593	*Less:* Custodian's charges	691	
4,236				5,971
85,831				91,319
	483	*Less:* Grant to general account	581	
		Accumulated fund written off	8,066	
483				8,647
85,348				82,672
		Accumulated Fund		
	(3,828)	Balance, deficit, brought forward	(5,708)	
	(1,880)	Deficit for year—general account	(2,358)	
	(5,708)		(8,066)	
		Less: Written off to Premises and		
(5,708)		Equipment Fund	8,066	
		Other funds		
		Library cataloguing fund		
	99	Balance at 1 November 1979	99	
		Plant mapping scheme: Research and publication fund		
	212	Balance at 1 November 1979	212	
311				311
79,951				82,983
		Current liabilities		
	2,100	*London Naturalist* provision	2,700	
	2,100	*London Bird Report* provision	4,800	
4,200				7,500
£84,151				£90,483

at 31 October 1980

1979			
	Assets		
73,192	**Quoted investments** at cost (Market Value £101,565)		73,579
	Funds at bank and on deposit		
	National Westminster Bank Ltd.:		
607	Current account	214	
100	Deposit account	3,100	
1,950	Investment deposit account	—	
62	Investment cash — Capital	120	
363	— Income	30	
7,833	National Savings Bank account	13,393	
10,915			16,857
44	**Cash in Hand**		47
£84,151			£90,483

Report of the Auditors to the Members of
the London Natural History Society

We have verified the above Statement of Affairs and attached receipts and payments account with the books and accounts of the Society and certify them to be in accordance therewith.

Knightway House,
20 Soho Square,
LONDON W1V 6QJ
21 November 1980

NORTON KEEN & CO.
Chartered Accountants.

General

1979		Payments		
385		Hire of halls, etc.		513
64		Lecturers' fees and expenses		130
322		Sectional expenses, including L.N.C.C.		437
8		Castell Research Centre		1
425		Library		565
93		Equipment repairs and renewals		16
647		*Programme* printing costs		605
382		*Bulletin* and *Newsletter* expenses		355
		Provisions —		
	2,100	*London Naturalist* **59**	2,700	
	2,100	*London Bird Report* **44**	2,700	
4,200				5,400
788		Mailing costs (*L.N.* **58**, *Programme, Bulletin* and *Newsletter* — postage, envelopes, etc.)		722
256		Costs of services (Auditors' fees, insurance, etc.)		298
405		Honoraria		405
101		Miscellaneous postage and telephone		132
27		Miscellaneous stationery		107
80		Sundries		15
		Atlas of Breeding Birds of the London Area		
181		Postages		6
		Memorial stone for Cyril Castell		249
£8,364				£9,956

Account

1979				
		Receipts		
4,347	Subscriptions — current		6,062	
8		arrears	16	
91		in advance	177	
63		entrance fees	70	
4,509				6,325
170	Donations			158
412	Tax recovered from deeds of covenant			207
23	Deposit account interest			52
483	Transfer from Premises and Equipment Fund		581	
35	Sale of surplus library stock		19	
518				600
	London Naturalist **58**			
1,900	Provision 1979		2,100	
1,910	Printing and expenses		2,472	
(10)			(372)	
3	Sale of offprints		71	
(7)				(301)
	London Bird Report **(42)**			
1,900	Provision			
1,724	Printing and expenses			
176				
424	Sale of journals		231	
50	*Less:* postages			
374				231
25	Subscriptions to *Bulletin*			27
	Symposium 1979			
545	Sales of tickets, etc.		535	
460	*Less:* Hire of halls, fees, etc.		448	
85				87
8	Sundry income			
	Atlas of Breeding Birds of the London Area			
165	Sales		108	
26	Royalties		104	
191				212
1,880	Excess of payments over receipts (transferred to Accumulated Fund)			2,358
£8,364				£9,956

LONDON NATURAL HISTORY SOCIETY

The Society welcomes new members, both beginners and experts. Its Area lies within a 20-mile (32 km) radius of St Paul's Cathedral and here most of its activities take place. Although much is covered with bricks and mortar, it is an exciting region with an astonishing variety of flora and fauna. The Society comprises sections whose meetings are open to all members without formality. For those interested in arachnology, archaeology, botany, conchology, conservation, ecology, entomology, geology, herpetology, mammalogy, ornithology or rambling there is a section ready to help.

Publications

The London Naturalist, published annually, contains papers on the natural history and archaeology of the London Area, including records of plants and animals.

The *London Bird Report,* published annually, contains the bird records for the London Area for each year, as well as papers on various aspects of ornithology.

Bulletins of news items, including the Society's *Newsletter* and the *Ornithological Bulletin,* are sent to members throughout the year.

Indoor meetings

These are held in most weeks throughout the year with lectures, discussions, colour slides and films on all aspects of natural history.

Field meetings

Led by experts to visit interesting natural history localities, many outside our Area. These excursions are very popular with beginners wishing to increase their knowledge and enable members to get to know one another.

Library

A large selection of books and journals on most aspects of natural history is available for loan or consultation by members free of charge.

Reading circles

Many important natural history journals are circulated by the sections at a fraction of the cost of subscribing direct.

SUBSCRIPTIONS

ORDINARY MEMBERS	£6·00
JUNIOR MEMBERS	£3·00
SENIOR MEMBERS	£3·00
FAMILY MEMBERS	£1·25
SUBSCRIBER MEMBERS	£6·00

The entrance fee is £0·50. Junior membership is for persons under 18, or under 25 and receiving full-time education, and Senior membership is for persons over 65 who have been continuous members of the Society for ten complete years. All except family members receive one free copy of *The London Naturalist* and the *London Bird Report* each year. Cheques and postal orders, payable to the London Natural History Society, should be sent to:

The Membership Secretary, P. C. Holland,
Flat 9, Pinewood Court, 23 Clarence Avenue,
London, SW4 8LB

THE LONDON NATURALIST

Back numbers of *The London Naturalist* are available as follows:
No. **39** (1960) — **47** (1968); **49** (1970) — **52** (1973): £1 each post free. No. **48** (1969): £0.50 post free. No. **53** (1974) — **54** (1975): £1.50 post free. No. **55** (1976) — **58** (1979): £2.50 post free. No. **59** (1980): £3 post free

These, and back numbers of the *London Bird Report,* may be obtained from the Publications Sales Secretary, Mrs H. M. Housego, 110 Meadvale Road, Ealing, London W5 1LR. Reprints of the Index to *The London Naturalist* **32**–**51** are available for £0.25 post free. Reprints of the *Annual Rainfall Overlay, Master Grid Overlay, Habitat Overlay, Regolith Overlay* and *Air Pollution Overlay* are free on receipt of a stamped addressed envelope.

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